THE ALLAHABAD FARMER

A BI-MONTHLY JOURNAL

OF

AGRICULTURE AND RURAL LIFE

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THE introduction of the new powerful, synthetic Insecticide "GAMMEXANE" has caused increased interest to be taken throughout the world in the chemical control of agricultural pests. This has occurred for three reasons :

(1) "GAMMEXANE" has proved itself to be much more powerful against those pests which were normally controlled by Arsenic and Nicotine Insecticides.

(2) Owing to its powerful nature, it can be used against pests such as wireworm, cutworm and leatherjackets.

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Besides its uses in agriculture, "GAMMEXANE" has proved its value in destroying insect pests of stored grain, cattle parasites and pests of Public Health—such as house-flies and mosquitoes.

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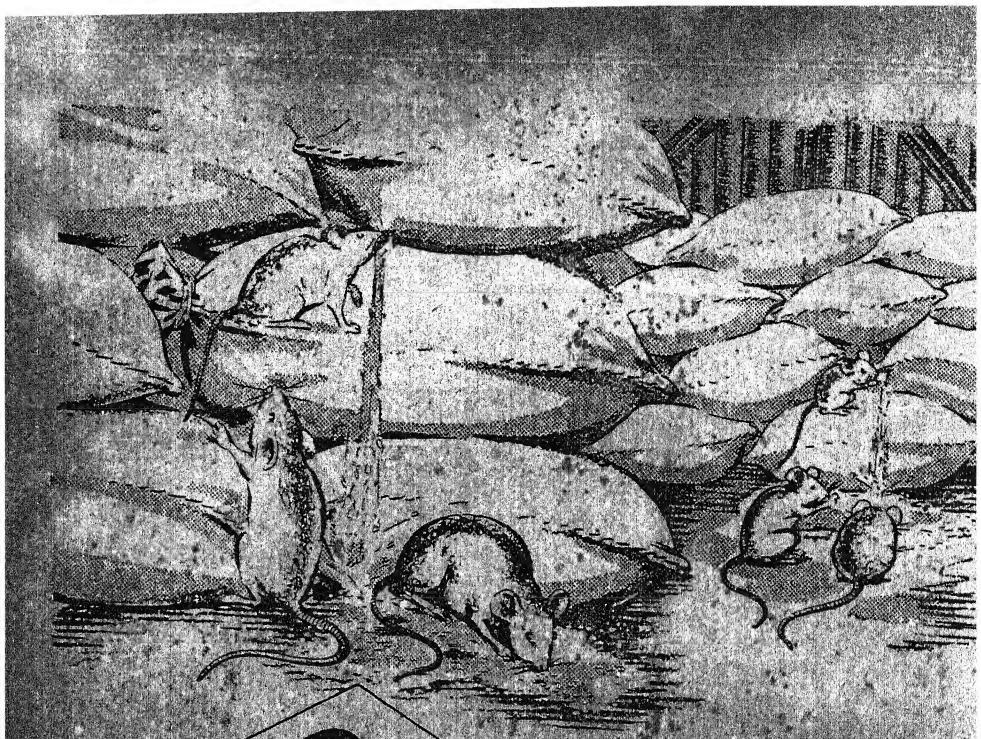

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Every year 3,000,000 tons of foodstuffs in India & Pakistan are irreparably destroyed *during storage*, by rats and weevils.

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"GAMMEXANE"

Prices: "Gammexane" Dust D.034 — Rs. 83/- per 1 cwt. drum.
"Gammexane" Smoke Generators No. 12 — Rs. 4/8/- each, Rs. 145 per case of 36.
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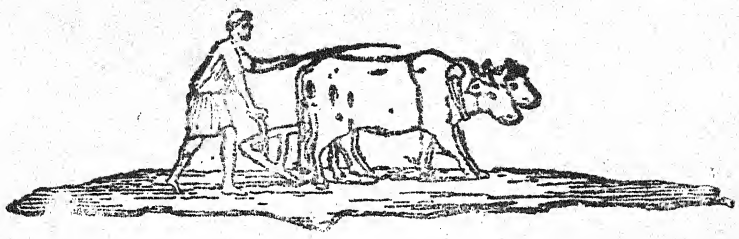

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'DEAD HEARTS' OF SUGARCANE.

By

T. DEAN.

During the earlier stage of cane growth a high percentage of mortality has been noticed due to the attack of borers. Their attack at this stage has always resulted in the production of "dead hearts" or drying of the central spindle. The purpose of this article is to give the external features of the 'dead hearts' caused by different borers, so that by examining them one can easily find out the causal agents without damaging the dumps that may give rise to new canes. This will also help the growers to know the past positions of their fields and to get departmental help.

Cause—In the early stage of cane growth the node formation of cane is very limited and at this stage an attack by borers is not confined to the nodes but attacks the growing points also. This damage to the growing point results in stoppage of the supply of nutrients to the growing tissues thereby causing the drying of the central spindle, or 'dead heart.'

Causal agents—There are three types of borers that cause 'dead heart.' Top borers (*Scirpophage nivella*), Stem borer (*A. stictieraspis*), Root borer (*E. depresselle*).

In the early stage of cane growth all three of these borers have been found. to produce 'dead heart' with characteristics quite different from each other. A careful examination of the canes reveals the following characters.

Top Borer—*S. nivella*—In most of the 'dead heart' produced by this borer, the central spindle is not complete, but only 3/4 to 1/2 of the total length is found to be present. The mid rib tunnel will always be noticed in one or two of the green leaves as this borer always feeds in the soft tissues of the mid rib before entering the cane tissues. The colour of the dead heart is reddish brown or black. The number of leaves forming the 'dead heart' in most cases is not more than two, when pulled it does not come out easily. The most distinguishing feature of dead-heart is the presence of 'short' holes. The holes made by the borers look like gun shots and have a burnt appearance.

Stem borer—*A. sticticraspis*—The 'dead heart' produced by this borer is more prominent in the field than that of any other borer, and is easily noticed because of the straw colour of the 'dead heart.' The central leaves forming the 'dead heart' in this case remain in a compact mass. The number of leaves forming the 'dead heart' is usually three. The distinguishing characteristic of this borer is that when pulled off, it comes out easily and emits a rotten smell from the base.

Root borer—*E. depresella*—The 'dead heart' caused by this borer has got the same straw colour as that of stem borer, but the leaves not being in a compact mass, they are not so prominent in the field. In most of the cases the number of leaves forming the 'dead heart' is four while in some cases three leaves can also form the 'dead heart.' While pulled off it does not come out nor does it emit the rotten smell as in case of stem borer.

TABLE SHOWING THE CHARACTERS OF 'DEAD HEARTS.'

Borers	Colour	No. of leaves	Can be pulled out or not	Basal smell	Description of leaves forming the dead heart	Description of the green leaves
Top borer..	Reddish brown or black.	2	No	No	Only 3/4 to ½ of the total length is left.	Mid-rib tunne and shot hole present.
Stem borer	Straw	3	Yes	Yes	Forms a compact mass.	Sometimes le blade is eate and holes mad
Root borer	Do.	3 to 4	No	No	No definite mass	No damage the gree leaves.

Thus a careful examination of the 'dead hearts' in the field can help t determine the causal agents without destroying the whole clump.

— —

"There is nothing grateful but the earth: you cannot do too much for it: it cont to repay tenfold the pains and labours bestowed upon it."

—LORD RAVENSWORTH.

VERTICAL FARM DIVERSIFICATION.

Reported by

W. H. WISER[1] AND A. T. MOSHER[2]

Dr. W. H. Wiser, Director of India Village Service, has brought to our attention a stimulating paper in the Proceedings of the Twenty-Fourth American Country Life Conference, held in Chicago in 1944. The paper was prepared by Mr. D. Howard Doane, President of Doane Agricultural Service, Inc., St. Louis, Mo.

Mr. Doane's argument is that many farms in America could be made more profitable by including the partial processing of agricultural products in the farm business. Feeling that, under conditions in India, such processing would better be added to the economy of larger villages than to the economy of the individual farmer, *The Allahabad Farmer* has asked Mr. Mason Vaugh, Agricultural Engineer of the Allahabad Agricultural Institute, to write the article of comment which follows this article in this issue.

In his paper before the American Country Life Conference, Mr. Doane stated:

"The next big step in the building of farm machines will come in supplying large farmers and co-operative groups of small farmers with stationary and semi-movable processing machines. They will permit unit operations for the first one or two steps in the processing of farm crops. They will squeeze out excess water and leave it at the source of production, thus cutting down on the transportation bill. They will separate lignin and minerals from cellulose leaving the former on the farm to sustain fertility and permit sending the cellulose to the paper maker."

"Let me be more specific and list some of the fields where machines will work.

"1. *Extraction* of oil and protein from such seed as cotton, soybean, castor, sunflower, flax, peanut, tung, perilla.

"2. *Digestion* of cellulose from plant stalks such as: castor bean stalks, all kinds of grain straw, cotton, corn, soyabean stalks. This process is the first step in paper making. Cellulose takes air, sunshine and water to the factory and leaves the vegetable matter and minerals at the community or farm plant.

"3. *Dehydration* of alfalfa, potatoes, fruit residues, green grain, hybrid corn crops, cotton, milk direct from cow, vegetable residues.

"4. *Compression* of stalks, straw, cotton or wood waste, under different degrees of density to make boardlike materials.

"5. *Fabrication* and separation of cotton, flax, wool, mohair, and floss which can be spun or woven into needed farm products such as sacks, tarpaulins and other coarse goods.

"6. *Refrigeration* by community units of individual farm and home units.

"7. *Distillation* of essential oils and alcohol from grain or starch crops.

"8. *Concentration* of stalks, straw, cobs and waste to be used for industrial purposes.

"9. *Mixing* of feed vitamin and mineral which may change entirely present methods of processing.

"10. *Grinding* of hulls, straw and cobs for plastic fillers.

"11. *Construction* of fabricated equipment and various types of farm buildings. They are made at central plants and ready for use when moved from manufacturing point to farm. Also staves, boxes, bundles, farm yard furniture.

"12. *Measurements* by machine and equipment for weighing, testing and measuring. All manufacturing demands a full compliment of testing equipment, but agriculture has lacked this in the past."

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1. Director of India Village Service, Nur Manzil, Lucknow, U. P.
2. Department of Extension, Allahabad Agricultural Institute.

POSSIBILITIES OF RURAL INDUSTRIALISATON.

By

MASON VAUGH, B. Sc., Ag., B. Sc. Eng., A. E.

There is rightly a very widespread interest in industrial development in India. This interest in and desire for industrial development is, again quite rightly, associated with a dread of the evils associated with dense concentrations of population in industrial centres like Cawnpore, Bombay, Calcutta and Ahmedabad. Everyone recognises that where there are dense concentrations of labour with no alternative means of support other than employment on wages, there is the probability of abuse of labour by management and of labour unrest and agitation; these are almost certain to be associated with slum living conditions, lack of sanitation, health hazards and often low moral standards. It is generally recognised that those living in rural areas live under better physical conditions. They have space, fresh air, the beauty of open fields, and usually better, cheaper and more abundant food supplies. Children in the country grow up under better conditions, free from many of the temptations and distractions of the city.

In the hope of preserving the advantages of rural living, many have advocated development of cottage industries and the foregoing of the advantages of higher income possible in the cities. However, the villages are now overcrowded, there is a large body of landless labour in the villages; agricultural holdings are already very small and do not offer scope for employment of the landless labour at remunerative rates. Cottage industries are generally thought of as part time occupations, to be engaged in at certain seasons when farm work is not required. In India with a climate and soil allowing the growth of crops throughout the year, it seems better for the farmer to devote his time exclusively to farming and for research to be directed to finding ways of making possible profitable farm operations throughout the year. Division of labour and specialisation in one type of production has resulted in a higher standard of living, in those countries where it has been practiced, than is possible in situations where every family or small group is self-contained and self-sufficient.

Mr. Doane has drawn up an excellent list of those industrial processes which are adapted to the utilisation of small scale power operated machinery, thus making possible the economies of factory production methods. The raw materials for these industrial processes are agricultural products and several of them can be available in almost any rural community. Some of the end products of these processes are directly usable locally. Others are semi-processed material for other industries. Most of the latter are much more concentrated than the original raw material and, therefore, reduce transport costs to the larger processing centres. Some of the suggested industries separate industrially valuable fractions of agricultural raw materials, of little value to the farmer, leaving the fraction that is valuable in the local economy and the part which carries away soil fertility for local consumption and makes possible the eventual return to the soil of the fertility components.

If, as stated above, it is better for farming to be a whole time profession, the same reasoning would apply to industry, that is, the industry which provides full time employment the year round will be more attractive and remunerative to labour than will be industries which operate only part of the year. Let us see how far this can be met by the suggested industries.

The processes suggested by Mr. Doane can be grouped into several groups. For instance, extraction, fabrication, distillation and grinding are processes which extract commercial materials from local products, leaving locally usable residues, or they process these residues. They can be combined into small factory processes which will give year round employment not only to men but to the

machines. In some cases, it will be necessary to store raw materials for processing in seasons when they are not produced, in other cases the product can be varied from season to season, utilising the same machinery. Digestion, compression, and concentration again form a group of processes using similar raw materials and similar processes which combine into the possibility of year round operation.

Dehydration, item 3, combined very probably with canning and bottling which are not listed, again form a combination which uses somewhat similar techniques and raw material, some at least of the same equipment, have a common market and which taken together would provide year round markets for intensive gardening production. This processing of food products for shipment to distant markets as well as for local consumption can very well be carried out in comparatively small local factories, requiring only modest capitalisation. Having them near to local supplies of the raw material results in the minimum movement of perishable things previous to processing and the maximum economy in movement of the processed materials. These are particularly suitable for small factory installation. They require technical skills and controls which are difficult to provide in homes, for their economical and safe carrying out.

Item 6, refrigeration of food products, seed potatoes, fruits and vegetables might well be associated with the previous group or can in many cases be carried on as a separate business. Many fruits, vegetables and dairy products can be made available over a longer season by nothing more than refrigerated storage, thus widening the market, reducing prices to consumer at seasons of scarcity, and at the same time giving the farmer better prices during the periods of maximum production when the direct consumption market does not absorb the full production at profitable prices. This is probably an industry for the larger market towns rather than for the villages proper. In general, it should have shipping facilities available, either by rail, road, or water, so that surplus production can move to larger markets readily. There is every reason to expect a very widespread development of commercial refrigeration in India in the near future. Conditions are favourable for it to be widely spread throughout the country. Many small towns and cities would support a "locker plant" where refrigerated lockers could be rented to local users as an alternative to personally owned household refrigerators.

Item 12, the provision of measurement, testing and grading services, can be associated with any or all of the above. This service by a third party who might be bonded or licensed by public authority, would be a protection to small sellers against unscrupulous dealers. Item 9, the preparation of mixed feeds, might also be associated with any one or several of the above industries, utilising byproducts with or wihout the addition of other materials, to provide feed for dairy cattle and other animals. To prevent sharp practices, a labelling law may be desirable particularly for this industry.

Items 5 and 11 (fabrication and construction) again fall into a slightly different class. Not only can the production of coarse goods such as those suggested be carried out in small factories, but the production of all sorts of cloth can be so done. The advantages of relatively cheap, contented and abundant labour, low-cost sites, abundant water and other advantages of a small town location may well be greater than the advantages of location in a congested city area even for industries operating on raw materials not locally produced. Small factories in America have held their own in many cases against the competition of big firms and, in fact, in many cases actually supply components to the big firms for assembly.

The new India will certainly require a very large volume of furniture, doors and windows and other building components, carts, agricultural implements of simple sorts, but of improved designs and modern materials, and many, many other things which can well be made economically by relatively simple power machinery in small factories. Such production, carried out under suitably trained supervision, can compete with the output of the big factory in both quality and price. Location of such factories in small towns where labour can come from surrounding villages will allow the utilisation of surplus labour in the villages for needed industrial production without the disruption to family life and social organisation involved in the migration of the labour to distant industrial centres, often leaving the family behind. This sort of development is desirable from every point of view.

This desirable result can be secured through a factory organisation of industry which will provide for the use of technical skill and power operated machinery. It is the author's belief that the same desirable results cannot be secured to the same extent by any type of cottage organisation of industrial production for sale in the market. The factory organisation gives such superior opportunity for the use of power machinery and technical skill that better wages can result. *The wide dispersal of factories can give most if not all the advantages of village life to the individuals combined with keeping the more intelligent and progressive fraction of the villagers in the community.* Unless such opportunity for remunerative employment can be provided in rural communities, the drain of talent to the cities is bound to go on. I believe that the organisation of such small factories in the small towns and possibly in the larger villages can provide a large measure of such employment, at the same time making locally available the large volume of industrial products needed to provide the abundant life desired by all.

AFTER TWELVE YEARS OF RURAL WORK

The late K. T. Paul, O.B.E., Rural Secretary of the National Council of the Y. M. C. A., India, Burma and Ceylon, in an extended article in the Indian Review, July, 1926, in which he discussed some lessons and warnings growing out of his twelve years of experience in rural work, made the following statement:

"The conclusion was driven in upon us that *the Indian villager is not helped unless he is helped simultaneously in every phase of his life, and in regard to every relationship he bears to others. The service must be comprehensive to get anywhere, and it must be simultaneously comprehensive. In other words, what is wanted is not reform but reconstruction, from the center out and all round.*" (The italics are as originally printed.)

The experience of creative workers in the rural field since K. T. Paul confirms this great Christian rural prophet's wise observation. The Christian mission's task in the village must comprehend all of it, if it is to deal adequately with it.

—*A. M. N., October*, 1938.

FURTHER RESULTS WITH VIJAYA WHEAT.

By

E. F. Vestal, Ph.D., Officiating Head of the Department of Agronomy,
Allahabad Agricultural Institute.

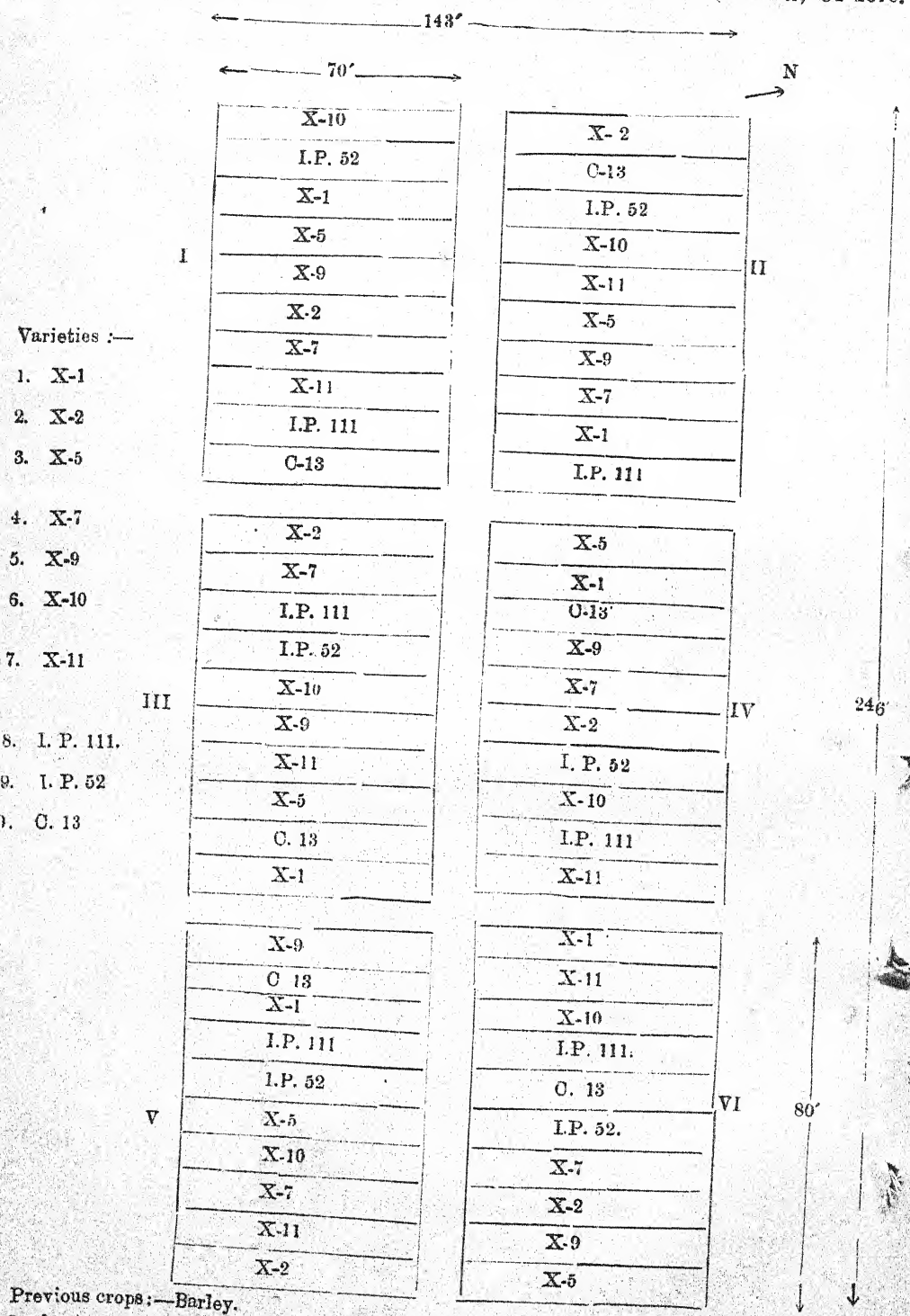
In the November, 1945 issue of the Allahabad Farmer, Mr. B. M. Pugh, Head of the Department of Agronomy of the Allahabad Agricultural Institute (now on sabbatical leave) gave a report of the results obtained with the Vijaya wheat, which had been selected from a strain of I. P. 52 treated with X-Ray by Dr. Shri Ranjan, Head of the Department of Botany, Allahabad University. In that report it was concluded that X-9, of the X-rayed wheat, was best.

In the 1945-46 Rabi season, seven of the treated wheats, *i.e.* X-1, X-2, X-5, X-7, X-9, X-10, X-11 were given further trials on the Institute Farm. I. P. 111, I. P. 52 and C. 13 were also used in the tests.

The trials were made in two layouts, differing somewhat in the size of plots. In Layout No. 1, the plot size was 8′×81′ without the non-experimental and in Layout No. 2 the plot size, without the non experimental, was 6′×66′. Rust resistance was determined by assuming a maximum value of six as rust free and a value of 0 for 100 per cent infection. Thus a high score indicated rust resistance. Data in the other tables are self-explanatory.

Under the 1945-46 conditions it will be noted that the irradiated wheats were not outstanding. X-9 was highest in *bhusa* in Layout No. 1 and stood high in most other respects. It will be noted that in only a few cases did any one variety stand out significantly better than the others.

1945-46. *Wheat Varietal* (Khanti) ·81 acre.



Varieties :—

1. X-1
2. X-2
3. X-5
4. X-7
5. X-9
6. X-10
7. X-11
8. I. P. 111.
9. I. P. 52
10. C. 13

Previous crops:—Barley.

Seed rate :—35 seers per acre.

Rust Resistance :— (Khanti) Low place.

Variety	BLOCKS						Total
	I	II	III	IV	V	VI	
X-10	2	3	2	2	2	2	13
I.P. 52	2	3	4	3	4	4	20
X-1	2	3	3	3	3	2	16
X-5	1	1	1	1	1	1	6
X-9	3	3	4	5	4	3	22
X-2	1	1	2	4	3	2	13
X-7	2	3	4	5	3	3	20
X-11	1	2	3	3	2	3	14
I.P. 111	1	3	2	2	2	2	12
C. 13	2	3	3	3	4	3	18
Total	17	25	28	31	28	25	154

Significant difference : 7·7.

X-9	I.P.52 & X-7	C-13	X-1	X-11	X-10 & X-2	I.P.111	X-5
22	20	18	16	14	13	12	6

Yield of grain only in seers. (Khanti) Low place.

Variety	BLOCKS						Total
	I	II	III	IV	V	VI	
X-9	5·0	3·5	3·0	6·0	4·5	5·5	27·5
C. 13	6·5	4·0	5·0	3·5	4·0	5·5	28·5
X-1	4·5	2·5	2·5	3·0	3·5	3·5	19·5
I.P. 111	5·25	3·0	4·0	4·0	5·5	4·0	25·75
I.P. 52	3·0	4·0	2·0	2·5	4·0	2·0	17·5
X-5	2·0	2·5	2·75	3·0	2·5	4·0	16·75
X-10	4·0	2·5	3·0	3·5	2·5	2·5	17·5
X-7	3·5	3·0	3·0	2·5	3·25	3·5	18·7
X-11	4·0	4·0	2·5	5·0	3·0	4·0	25·5
X-2	4·5	3·5	4·0	3·0	3·5	4·0	222-5
Total	42·25	32·5	31·75	36·0	36·25	38·5	217·25

Significant difference : 7·4.

C. 13	X-9	I.P. 111	X-2 & X-11	X-1	X-7	X-10 & I.P. 52	X-5
28·5	27·5	25·75	22·5	22·5	19·5	18·5	17·5	17·5	16·75

Yield of Bhusa only in seers :— (Khanti) Low place

Varieties	BLOCKS						Total
	I	II	III	IV	V	VI	
X-9	20	14·5	18	26	23·5	19·5	121·5
C 13	19·5	14	25	9·5	18·5	18	104·5
X-1	18 5	13·5	17·5	17	21·5	10·5	98·5
I.P. 111	22·25	15	17	15	21·5	15	105·75
I.P. 52.	21	16	23	12·5	23	8	103·5
X-5	14	14·5	18·5	11	18·5	18	94·5
X-10	22	12·5	22	17·5	18	15·5	107·5
X-7	16	12·5	6·5	9·5	25·25	17·5	87·25
X-11	13	13	18·5	17	27	12	100·5
X-2	15·5	18·5	19	12·5	19	18·5	103 0
Total	181·75	144·0	245	147·5	215·75	152·5	1086·5

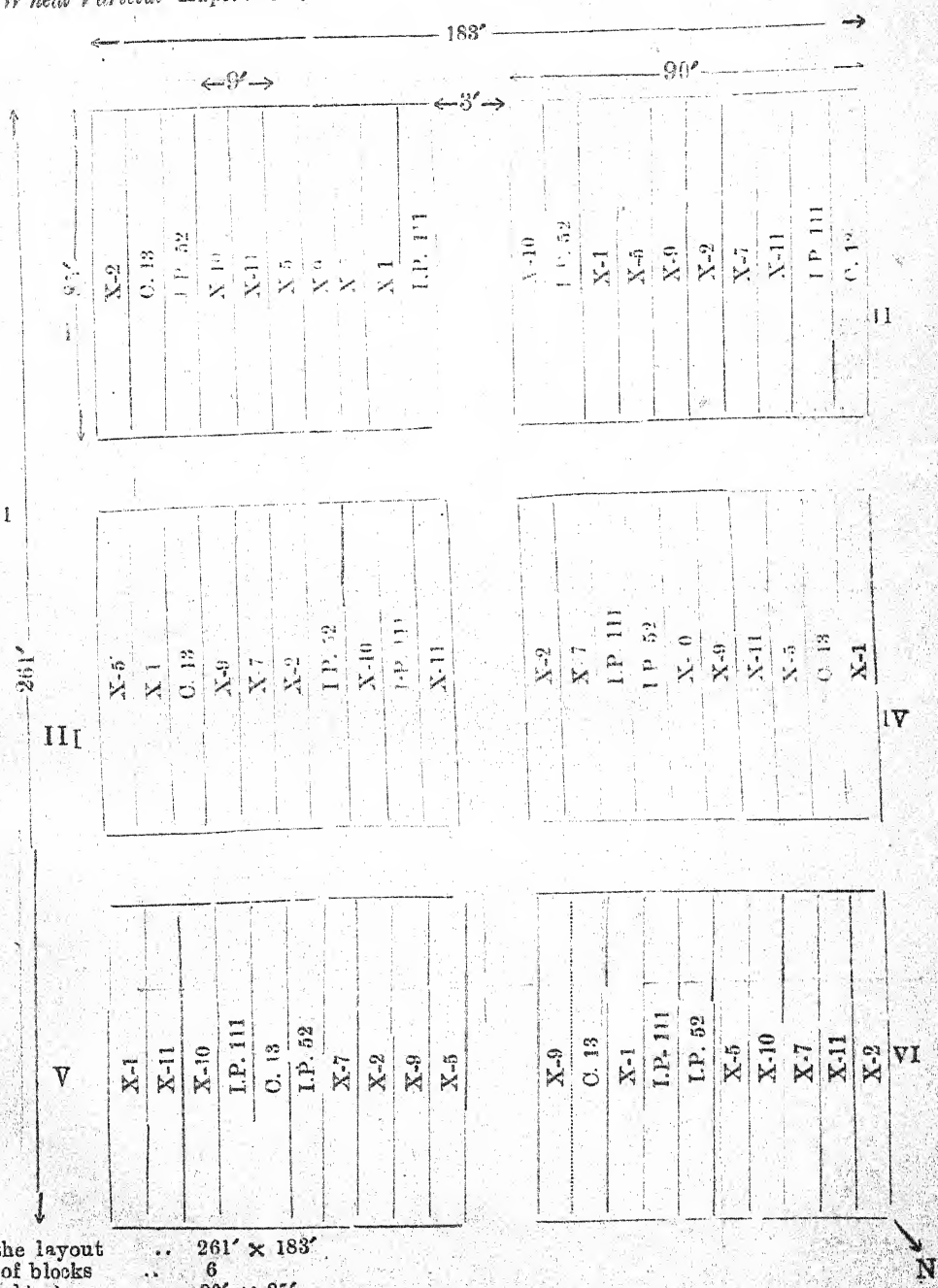
Significant difference : 29·4.

X-9	X-10	I.P. 111	C.13	I.P. 52	X-2	X-11	X-1	X-5	X-7
121·5	107·5	105·75	104·5	103·5	103	100 5	98·5	94·5	87·25

1945-46.

Area—1·09 acres.
High land.

Wheat Varietal Experiment.



Size of the layout .. 261′ × 183′
Number of blocks .. 6
Size of a block .. 90′ × 85′
Number of plots per block 10
Size of a plot .. 9′ ×85′
Number of rows per plot 9
Previous crops .. Green manured.
Seed rate .. .. 35 seers per acre.

Rust resistance :

(High land)

Varieties	BLOCKS						Total
	I	II	III	IV	V	VI	
X-10	3	4	4	4	4	4	23
I.P. 52	4	4	3	4	5	4	24
X-1	5	5	3	5	5	5	28
X-5	2	3	1	2	2	3	13
X-9	5	5	4	4	4	5	27
X-2	3	3	1	3	4	5	19
X-7	5	4	2	3	3	5	22
X-11	3	5	1	4	4	5	22
I.P. 111	3	5	4	3	4	4	23
C. 13	5	6	4	4	5	5	29
Total	38	44	26	33	40	45	223

Significant difference :—5·679.

C. 13 29 | X-1 28 | X-9 27 | I.P. 52 24 | X-10 & I.P. 111 23 | X-7 & X-11 22 | X-2 19 | X-5 13

Yield of Grain in seers :—

(High land)

Varieties	BLOCKS						Total
	I	II	III	IV	V	VI	
X-2	9·5	8·5	1·5	2·5	4·5	7·5	34
C. 13	9	8·5	5	9	5	5·5	42
I.P. 52	7·5	5·5	3·5	5·5	5	8	35
X-10	5·5	7	4·5	7·5	6·5	10·5	41·5
X-11	7	10	2	9	10	8	46·
X-5	3·5	6·5	8	5	4·5	7	34·5
X-9	6·5	10	2·5	9·5	6·5	7·5	42·5
X-7	7	10	2	3·5	7	8	37·5
X-1	7	7	11·5	10	14·5	7·5	57 5
I.P. 111	13	12	6·5	11	12·5	13·5	68·5

I.P. 111 68·5 | X-1 57·5 | X-11 46 0 | X-9 42·5 | C. 13 42 | X-10 41·5 | X-7 37·5 | I.P. 52 35·0 | X 5 34·5 | X 2 34

Significant difference :—10·2.

Yield of bhusa in seers :— (High land)

Varieties	BLOCKS						Total
	I	II	III	IV	V	VI	
X-2	35·5	30·5	38·5	40·5	32·5	15·5	193
C. 13	37·0	26·5	37·0	28·5	29·0	34 5	192
I.P. 52	40·5	39 5	37·5	22·5	39 0	29·0	208
X-10	34·5	43·0	28·5	32·5	32 5	36·5	207 5
X-11	38 0	36·0	49·0	34·0	37·0	33 0	227
X-5	26 5	28·0	32 0	27·0	36·5	25·0	175·5
X-9	25·5	31·0	32·5	30·5	38 0	37·5	195
X-7	38·0	35·0	32·0	43·5	37·0	39·0	224·5
X-1	46·0	39·0	44·5	28·0	37 5	37·5	232·5
I.P. 111	42·0	31·0	36·5	29·0	30·5	33·5	202·5
Total	363·5	340 0	368·0	316·0	350 0	321·0	2058·5

X-1	X-11	X-7	I.P. 52	X-10	I.P. 111	X-9	X-2	C 13	X-5
232·5	227	224·5	208·0	207·5	202·5	195·0	193 0	192·0	175·5

Significant difference :—26 5.

"In its profoundest sense farming is the civilization you carry in your soul as you plow the dirt and manage the flocks and fields."

—JOHN M. BREWSTER.

FARMING THE "CZECH" WAY[1].

By

JOHN STROHM

Agricultural Reporter, Prairie Farmer Magazine, Chicago, U. S. A.

You'd like Czechoslovakia! It has the beauty of the Ozarks, the good farming of Iowa. And it's as up to date as today's newspaper. Its social legislation makes our New Deal look like a relic of the horse-and-buggy days.

And after talking with farmer, worker, and President Benes, I think its people know as much about practicing the kind of democracy we (Americans) preach as any I've ever met.

High Morale

Czechoslovakia today should be required visiting for all statesmen and people who are afraid of the future. For this nation, whose constitution was written in Pittsburgh, is bouncing back from the terrible ordeal of war to to become one of the most progressive countries with the highest morale in Europe.

It is well balanced between agriculture and industry. The farmers are small landowners—94 per cent of their farms have less than 50 acres. There's been a lot of eloquence expended and a lot of tears shed over the small family farm. Czechoslovakia is *doing* something about it.

Help Small Farmers.

The farmer with less than 48 acres of arable land gets $ 1·40 for his wheat. The farmer with 48 to 120 acres gets but $ 1·29 a bushel. And the farmer with more than 120 acres gets only $ 1·21. The same goes for hogs—the small farmer gets 24 cents a pound, the middle-sized farmer gets 22½ cents, and the big farmer gets only 21 cents.

There are three prices for practically all farm commodities, and the little farmer always gets the highest. He also pays less taxes per acre.

The biggest farm news in Czechoslovakia is the fact that near the German frontier there are German farmers no more. They have been moved out back to the Fatherland Hilter prompted them to holler for in the days leading up to the tragedy of Munich.

Franticek is one of the 1,20,000 farmers who have been resettled on the 3,600,000 acres of land thus taken from the Germans in the Sudetenland. He was ploughing with a cow and a horse, his wife was planting potatoes, and their little tow-headed boy was playing under a tree when I visited them. They insisted that I come to their home, a quarter of a mile away in the village, and have a bite to eat. So I sat in their neat kitchen munching brown bread and delicious pork tenderloin while they enthusiastically told me about their new life in the new Czechoslovakia.

They had lived in Central Bohema until Franticek was rudely moved off his acre of land, and sent to forced labour in Germany. With liberation came opportunity. He and forty of his neighbours were given land around this village. Franticek got eighteen acres—good land, too.

He uses a mower to cut his hay, rakes with a big hand rake. He and his neighbours have a threshing machine and trade work. Some of his neighbours hire their ploughing done from one of the government tractor stations.

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[1]Reprinted by special permission of the author. This is one of a series of articles on European Agriculture written by Mr. Strohm after a European tour in 1946.

Needs Fertilizer.

He says the land needs fertilizer very badly, even though he is very careful to save every bit of manure, including the liquids which are pumped into a tank and carried to the fields. He raises a couple of hogs for meat, has six cows for working and for milk, and plants wheat, barley and sugar beets.

Along with half his neighbours, he belongs to the farmers' organization which keeps the Parliament informed of farmers' needs. He buys from a coop store and sells all of his produce to the coop which handles three fourths of the farmers' produce. He plans to join one of the breeders' organisations which seek to improve livestock through feeding and breeding and which hires experts to give the farmers advice.

Neat as a Pin.

Franticek's farm, like most of the others in this country, has a well-tended look like a formal garden or a country club golf course. The Czech farmer is as particular about his land and home as an old maid is about keeping house. They weed their wheat like we do our lawns.

Czechoslovakia expected a 90% of normal crop this year, in spite of the resettlement programme, the lack of fertilizer and shortage of draft power which makes a cow-horse hitch the most popular working team. But a spring drought has already cut production below that.

Although UNRRA tractors have been put to good use, farmers are crying for many more. Gasoline is so scarce they have equipped many of their old tractors and trucks to burn wood or charcoal.

Although Czechoslovakia could teach us a thing or two about better farming—how to save liquid manure, for instance—they have their problems. Along with many other European nations, this country is cursed by the fact that a farmer's land may be divided into two or three dozen tiny strips and scattered as far as five miles from his home. He wastes much of his time getting to his fields, and he can't make very good use of machinery.

A commission is now at work trying to consolidate these scattered strips. Around one village they combined 200 strips into 11 farms. Moravia and Bohemia now have a law which prevents a farmer from dividing his land among his children.

Czechoslovakia suffered terribly in the war. Thousands of farm homes were destroyed, thousands of farmers were driven from their farms.

Scars That Don't Heal.

But it's the mental scars which will never completely heal. I went out to where the little village of Lidice used to be, saw nothing but a grass covered hillside. The Germans shot the men and boys, killed most of the women and sent others to concentration camps, and scattered the little children all over Europe. They burned the village, even carted away the stones and changed the road to literally wipe Lidice from the face of the earth.

There's been a lot of talk back home about Russians running this country. That's an insult to the Czechs. If there are any more Russians than Americans here they must be hiding behind bushes. This nation seems to have enough self-confidence to say a friendly "hello!" to Russian and American alike, without fear of either. Any why not? This is a free country.

There's no question that Czechoslovakia has moved towards the Left. A good share of their industry has been taken over by the Government. I drove through many towns and villages on May Day, one of their biggest holidays, and saw tremendous celebrations. Always the Communist party parade was biggest of the four parties.

But let me tell you of a visit I had with Stransky, who had just been given an opportunity to buy some land taken from a German landowner who burned his buildings and fled with the retreating German armies. It was just a year ago, Stransky's wife recalled, that Germans machine-gunned their village, and their three children narrowly escaped.

Times Have Changed.

"How different it is today," she sighed. They have a home, enough land to support their family. Their boy could go to the agricultural college, their daughter could go on to school, too. They knew there was hard work ahead of them, but they knew their own strength and had confidence in their future. They were sure their Government was of, by, and for the people. They had just given up a few bushels of precious wheat which they really needed themselves—had given it to the Government because they knew others needed it worse.

Stransky was certain there could be peace if every individual took it on himself to work for it. His wife chimed in to say, "Yes, but there must also be a unity and co-operation among nations and the peoples of the world. Tell your Mr. Truman the best gift he can give us is to help keep the peace."

Communists.

This farmer and his wife told me they were Communists. I asked them if they would prefer collective farming.

"Of course not," they replied, "Just because we're Communists doesn't mean that we don't prefer to have our own land. That's not what Communism means."

President Benes of Czechoslovakia had something to say to me along this line: "Surely, you are doing a fine thing in writing for the farm people of America about the farmers and small town people of Czechoslovakia and other countries. They'll believe you because you are actually visiting us, and when you tell them how we live and what we think and about our problems—it's going to help the whole cause of peace."

"There is no excellence without labour. One cannot dream one's self into either usefulness or happiness."

A. N. M.—October, 1942. —LIBERTY HYDE BAILEY.

IMPROVEMENT OF QUALITY IN MARKET EGGS*.

T. S. KRISHNAN

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The average Indian diet is seriously deficient in quantity as well as quality, particularly in regard to essential nutritive and protective constituents like proteins, vitamins and minerals. The egg, which is one of the choicest of human foods, is specially suited to rectify these deficiencies. The average *per capita* consumption of eggs in this country has been estimated to be only about 8 a year, which is very low. Though economic factors, dietetic habits, religious prejudices and other similar reasons tend to keep egg consumption low, yet a good deal could be done to stimulate consumption, at least among egg-eaters, by improving the quality of market eggs. Consumers are the ultimate judges of quality and many of them are highly discriminating in this respect. They want eggs of high quality or, in many cases, none at all.

Of the annual egg crop the large majority is disposed of as market eggs for human consumption and the remaining smaller fraction is utilized as hatching eggs for breeding and replenishing the flock. Market eggs reach the consumer principally in the shell and to a small extent in the dried and frozen state. Regardless of the form in which they reach the ultimate consumer, the quality of the final product depends on the original quality of freshly laid eggs and on the methods adopted in their handling and storage. Newly laid eggs are usually of excellent quality, but being highly perishable, deteriorate rapidly if exposed to unfavourable conditions. Since no methods are known of improving the initial quality of eggs after they are laid, or of restoring quality already lost, it is of the utmost importance that the original quality should be preserved as far as possible.

In order to improve the quality of market eggs proper attention has to be paid to the numerous operations such as production, collection, testing and grading, processing, packing, storage, transport and sale. Quality in eggs may be broadly divided into two classes: (a) those relating to external factors, namely, size, shape, colour, cleanliness, etc., and (b) those pertaining to internal factors, such as, colour and texture of the yolk, thickness and consistency of the white, odours and flavours, presence of meat, blood and other faults occurrence of mould, rot, embryo development and other conditions rendering the egg inedible, etc. While the external factors can be easily judged and appreciated, it is difficult to appraise properly the internal ones due to the presence of the shell.

Exterior factors and egg quality

Consumers want eggs of good size and normal shape having a clean, smooth, sound shell and of excellent interior quality. Since most of the above factors are dependent mainly on the individuality of the bird, any improvement in the same could be brought about by the producer by keeping only a flock of good layers, selected for these qualities from a strain of known pedigree. In order to get the best out of such birds, they have to be fed, housed and managed properly, besides keeping the hygienic conditions of the farm at the highest level. Proper nutrition helps to keep up the number and size of the eggs as also their nutritive value, especially the vitamin content. The villagers, who are the main producers, being poor and ill-educated, keep whatever fowls are easily available to them. These birds are usually of unknown pedigree and, being left to shift for themselves for food and shelter, have a low efficiency. Further, due to the absence of proper management and sanitation, sickness and mortality

* Reprinted from Indian Farming, Vol. VII, No. 5, May 1946.

among the flock are high and cause a further fall in production. Consequently, the eggs produced are few in number, small in size, and often low in quality and dirty in appearance. The size of the egg, which is one of the most important factors requiring immediate improvement, cannot be increased till the layers now present in the villages are replaced by new stock of better pedigree and these latter are given proper nutrition, housing and management. Under present conditions, distribution of improved stock would not be of much use as the villagers have not got the wherewithal to feed and house the birds properly and are too ignorant to attend to the proper sanitation of their houses and surroundings. Till these conditions are remedied by educating them, by improving their economic condition and by ensuring a fair return for their produce, no spectacular results can be expected. However, these measures, being of fundamental importance, need the earliest possible attention. The alternative is to start numerous well-organized largescale commercial poultry farms where adequate attention may be paid to these several factors. This procedure though capable of yieding much quicker results than by improving village production, requires considerable capital, technical skill, practical experience and business acumen in order to make the project a success.

Cleanliness of shell is one of the important external factors which requires much improvement and immediate attention. Unlike most other external quality factors, specified earlier, this one is well within the control of the producer. It is important from the aesthetic as well as health point of view. An egg having its shell stained with blood, or coated with poultry excrement or other filth, is not only repulsive in appearance but is also a health—hazard as the contents is likely to be infected with undesirable micro-organisms. It is, therefore, essential that only clean eggs be produced. Providing clean litter in the nests, keeping the runs free from slush and puddles, as also confining the birds till about noon on wet days, would help to reduce the number of dirty eggs. The standard of cleanliness of the eggs sold in Indian markets is very low and provides scope for great improvement. Even after leaving the farm they become dirty by contact with filthy packing materials and the contents of broken eggs during packing and transport to the retailing centres. Adoption of measures to produce clean eggs will not only improve the quality, but will also help in getting increased profit in marketing.

The colour of the shell is largely a breed factor and cannot be altered by feeding, management, or other means. Though it has no relationship whatsoever with any of the interior qualities of the eggs, yet it has some importance from the sales point of view. An uniform shade in all eggs of a consignment presents a more attractive sight and thereby enhances their market value. Better results on the sales counter might be expected if eggs are sorted out into lots of uniform colour and shade.

Interior factors and egg quality

The testing and grading of eggs constitute essential and important steps in their proper marketing. These operations serve to classify them according to their exterior and interior qualities. Graded eggs fetch the maximum return to the producer and at the same time enable the consumer to have reliable and uniform products at reasonable rates. The interior quality of shell eggs is judged in commerce by a process called candling. In this, the contents of the eggs are judged by examining the eggs against a strong light, preferably in a darkened room. Experienced candlers can generally classify them according to their interior quality with a fair degree of accuracy and also eliminate most of the inedible ones without much difficulty. Except for some of the big packers of *Agmark* eggs, most of the merchants do little more than sort them out according to their size. A sort of crude candling, against the sun, may perhaps be carried

out by them, but this is highly unsatisfactory and is probably the main reason for the presence of such a large proportion of poor and inedible eggs in consignments exposed for sale. It is, therefore, clear that proper candling of eggs is one of the most urgent and essential measures to be adopted if any improvement in market egg quality is to be brought about.

Among the various factors such as temperature, humidity, fertility, period of storage, cleanliness of shell, etc., influencing egg quality, temperature is about the most important. High temperature brings about rapid deterioration in eggs causing liquefaction of the firm white, flattening out and eventual rupture of the yolk, as well as increase in air cell size due to evaporation of water from the contents. In the case of fertile eggs the embryo also develops rendering them inedible in a few days. To avoid these undesirable changes and conserve the original quality to the utmost, eggs have to be kept cool, the cooler the better, the usual range of temperature employed for this purpose being about 30° to 60°F.

In this country the bulk of the market eggs are produced in the villages by the cultivators and other poorer classes of people, who generally keep a few fowls each as a side line. Usually the eggs are purchased from them by professional egg collectors who visit the villages either daily or at intervals of a few days, according to the volume of collection available. They are then sold to contractors who are generally agents of wholesalers. These latter distribute to the retailers who, in turn, sell them to the ultimate consumers. Consequently, eggs take a few days to reach the urban consumer from the rural producer. This interval has been estimated to be, on an average, about a week. During the entire period they are handled only under ordinary atmospheric conditions. Since temperatures in most parts of the plains of India for several months in the year are high, reaching up to about 120°F. in some places during the very hot months, eggs exposed to these conditions rapidly lose quality. Further, as the market eggs are usually all fertile, embryonic development also goes on apace and large numbers become inedible by the time they reach the consumer. These heavy losses, besides being a serious threat to the prosperity of the egg trade, are also highly deplorable as they constitute an unpardonable waste of a very valuable food material, particularly at this period of acute and world-wide scarcity.

Methods for improving interior quality of market eggs

The best method of ending this colossal waste and setting matters right would be to handle the eggs, as far as possible, under the requisite low temperature conditions by the use of ice or the employment of suitable mechanical refrigeration. However, the smallness of the size of the units of production, the poverty of the people engaged in the business, their low standard of education and technical skill, the lack of necessary facilities for refrigeration in most rural areas and the low price of eggs prevalent during normal times are some of the important factors which render the general adoption of the above suggested remedy impractical and uneconomic. The other obvious alternative would be to produce only infertile eggs, except during the breeding season, by removing the males from the flock. Though infertile eggs also deteriorate in quality when exposed to high temperatures, yet they remain edible for much longer periods than fertile ones under similar conditions. This apparently simple measure is also extremely difficult of largescale adoption in villages, due to the practical difficulties in keeping all the male birds of the locality segregated for several months in the year, or of killing them off wholesale at the end of the breeding season and replacing them afresh during the next. To meet these very special conditions some cheap and simple methods have been evolved in the Poultry Research

Section, Imperial Veterinary Research Institute, Izatnagar, the adoption of which would go a long way to reduce markedly, if not prevent entirely, the embryo development which accounts for the bulk of the loss among market eggs during the hot weather. A brief summary of some of the important ones is given below.

Storage of eggs in egg cooler

One of these methods recommends the use of an iceless egg cooler for storing eggs. Good results can be obtained with a simple cabinet, constructed more or less on the model of a domestic meat safe, with wire netting sides and bottom. The cooling is brought about by the spontaneous evaporation of water from wetted hessian cloth suspended on all the four sides of the apparatus. These are kept continuously wet by keeping their upper ends dipping in a tray of water placed on top of the cabinet. Fertile eggs stored in such a cooler during the hot months of May and June show no marked germ development for about ten days while similar ones kept outside at the same time become rejects within about four days, showing considerable blood in the embryo. The keeping quality of the infertile eggs also was markedly improved by storage in this apparatus under the above conditions. This cooler, however, was not effective during the humid, monsoon period.

Defertilization of eggs

A better and more satisfactory process is the defertilization of the fertile eggs, which is carried out by merely keeping the eggs immersed for 15 minutes in water maintained at 55°C. This method, being very simple, can be employed by anyone with average skill at little expense. The treatment destroys the fertility of the eggs, which is the cause of such rapid spoilage, without affecting their other qualities and renders them as good as infertile ones. The defertilized eggs are equal, if not slightly superior, to naturally infertile ones in their keeping quality. Since this method does not depend on the weather or other uncontrolled external factors for its success, as in the case of the cooler described above, it can be employed in all seasons and at all places with equal efficiency. When employing this technique, better results could be ensured by paying special attention to the following points: (a) eggs for defertilization should be carefully selected for high interior quality and soundness of shell, by proper candling, and (b) the processing should be carried out as quickly as possible after they are laid in order to retain as much of the original quality as possible and obtain the maximum benefit from the treatment. If for any reason embryonic development has proceeded too far or quality has otherwise been seriously lowered, in any lot of eggs, it would be best to reject them altogether as defertilization cannot remedy such defects and restore lost quality. Defertilization of such eggs would merely be a waste of time, labour and expense. It would be most efficient and economic to arrange for the defertilization of the eggs to be carried out at the primary points of largescale assembly. This would enable the processing to be done at the earliest practicable stage after their collection and also ensure sufficient bulk for the most efficient utilization of the available materials and facilities.

By combining both the processes, *viz.*, defertilization and subsequent storage in the cooler, the quality of the market eggs could be maintained at a higher level for a longer period than by either process alone. In eggs which have to be transported over long distances during the hot weather, embryonic development and excessive shrinkage of contents constitute the chief causes of loss in quality. The former could be entirely prevented by proper defertilization according to the process already described, and the latter can be greatly reduced by holding the eggs in lime water for a day before despatch to the desired destination. The lime water treatment serves to seal the shell pores, through which evaporation of water takes place, thereby minimizing shrinkage.

Long term preservation of egg quality

The methods and processes described above are only suitable for reducing quality losses in fresh eggs during the few days required for them to reach the consumer in the course of ordinary marketing operations. When seasonal surpluses are held over for long periods, the maintenance of high quality becomes a very complicated problem requiring the adoption of measures for controlling losses in egg meat quality, reducing shrinkage, preventing the growth of moulds and rots, avoiding the development of cold storage taste, etc. In the modern commercial cold storage plants, where eggs are stored for long periods, elaborate precautions are taken to overcome the difficulties mentioned above by careful regulation of temperature, humidity and ventilation, the employment of gases like carbon-di-oxide or ozone, by attending to the quality and cleanliness of eggs and packing materials, and other cognate factors. These operations, however, are not of immediate practical importance in this country due to the absence of big seasonal surpluses of eggs which have to be held over in cold storage for several months and put on the market later on.

Still another method, generally employed in western countries to mainta in the quality of market eggs for long periods, is oiling. In this process the eggs are just dipped and taken out of certain patented oils or other similar preservatives, like 'Oteg,' which have been specially prepared for this purpose. This treatment, by coating the shell with a thin film of the oil, seals the shell pores and thereby helps to minimize shrinkage and the attendant concurrent losses in internal quality. When the eggs are fertile and temperatures high, as is prevalent in this country, not much benefit can be derived from oil dipping unless they are stored at sufficiently low temperatures. However, marked improvements could be obtained under the above conditions, even in the absence of refrigerated storage, if the eggs are defertilized before oil dipping. The drawbacks in adopting this procedure are the additional cost due to the oil and the prejudice on the part of consumers in the free acceptance of these eggs due to the greasiness of the shell. If these could be got over, the method is well worth adoption and would certainly contribute to a decided improvement in market egg quality.

Miscellaneous factors in marketing good quality eggs

Large losses, amounting up to about 50 per cent are not uncommon in some consignments of eggs sent over long distances, due to breakage and its attendant causes. Broken eggs, besides being a total loss, cause further damage by soiling the shells of undamaged ones. Since the packing material is usually dirty and the temperature conducive to bacterial growth, putrefaction sets in. This proceeds to the cracked eggs and even to those with sound shells. A large reduction in breakages and marked improvement in egg cleanliness and quality could be brought about by selecting a fairly rigid container and using a sufficient amount of clean, colourless, light and resilient packing material between the layers of the eggs as well as on the bottom, sides and top of the package. More careful handling of the packages is also very essential to keep down breakages to the minimum. The extra trouble and expense involved by the adoption of the above suggestions would be well worth incurring as they would be repaid several times over by the profits resulting from the savings in cracked, smashed, dirty and rotten eggs.

The rate of movement of eggs from the farm to the market also needs considerable speeding up. More frequent collection of eggs from the villages would ensure their quicker assembly and if they are tested and graded as well as processed and packed with the utmost expedition, much unnecessary loss of quality could be avoided. It often happens that eggs in transit lie on station platforms, exposed to sun and rain for hours on end, sometimes even for a whole day or more, before being sent on to their destination. These delays

should be eliminated and egg packages must be recognized to contain highly perishable material which need the quickest possible transit facilities as well as more careful storage and handling *en route*.

Since eggs rapidly pick up odours and flavours from the surroundings, and as there is no method of detecting this fault till they are broken out, they must not be stored near strong smelling articles like fish, onions, kerosene, etc.

By recognizing that the egg is a valuable foodstuff which is highly perishable, and needs special care and attention in all the stages of production and marketing, and by adopting one or more of the methods suggested above, a decided improvement in market egg quality could be brought about in a comparatively short time, even under the existing unfavourable conditions.

AUSTRALIAN CHICKS BY AIR

The first consignment of chicks since the end of the war has been sent by flying boat from Australia to Java.

About 3,000 day old chickens from one poultry-raising firm alone are flown each week to Malaya.

Poultrymen in Fiji, New Caledonia and New Guinea have ordered air consignments of chickens from Australia.

—Agricultural Newsletter.
Release No. AGN/140.
21-11-1946.

SOYA BEAN.*

Within recent months much has been said and written, some of it in this journal, of the merits of soya bean as an article of food We have now before us the *Report on Soya Bean* submitted by the special sub-committee of the Indian Research Fund Association's Nutrition Advisory Committee. It is an authoritative statement which does nothing to strengthen the opinion that in the soya bean lies the solution of many of India's dietetic problems. The Woodhead Famine Inquiry Commission agreed with the finding of the Nutrition Advisory Committee. We learn from the Committee's report that the bean was introduced into America as long ago as 1829 and to Europe in 1873 where it has been grown extensively in the eastern countries. In the United States it is now a crop of importance, no less than 2·625 million tons being produced in 1941. It has not been cultivated to any great extent in India although 30 years ago some 20,000 acres were being grown in north Bengal, Nepal, Bhutan and Sikkim.

The Nutrition Advisory Committee in 1937 stated that 'The nutritive value of soya bean has been studied by experiments on animals and also by controlled experiments on school children. The general conclusion is that soya bean, considered as a supplement to typical Indian diets, is not of outstanding value ; it does not appear to have any advantage over various common pulses which have long formed part of the diet of the Indian people. While it would be advisable that the results obtained in the Coonoor Laboratories should be confirmed elsewhere, existing data suggest that at present the encouragement of the production and consumption of soya bean need not be made a prominent part of nutritional and agricultural policy in India.'

The soundness of that opinion was questioned both within and without the Committee, so that at the seventh meeting of the Committee in 1941, it was decided that 'further work was necessary to elucidate the problem.'' Accordingly, a sub-committee was appointed to suggest lines on which further experiments on soya bean might be carried out by different laboratories, and it is the record of the work done by experts in the laboratories in Dacca, Bombay, Lahore and Coonoor that is to be found in the present report. Be it understood that it is the nutritive value of the bean that is under examination and that an examination of its many other attributes did not form a part of the Committee's duty. The industrial value of the bean is beyond question ; the residue of oil extraction is a valuable cattle food, the yield per acre is high. The work with which the sub-committee was confronted was an examination of the growth-promoting value of the bean and of its relative ability to adequately supplement poor rice or other cereal diet.

As regards the value of the bean as a milk substitute for infants, Mackay assesses the value of the work published up to 1940 in the following words: 'No authors have published any detailed statistical results whereby the progress of babies given soya preparations can be compared with that of similar babies living under similar conditions but given preparations of cow's milk. Judging by the statements and conclusions of the authors, it seems, as might be expected, that babies fed on soya flours without any admixture of cow's milk do not, on the whole, make as good progress as babies having milk as the basis of their diet'. The Committee's opinion on the subject is that ' It is clear the question of using soya bean in the feeding of infants and children in India needs to be approached on an experimental basis, and with caution. A necessary prilimiary stop would be careful trial in infant welfeare centres of suitably supple-

* Reprinted from " Indian Farming," Vol. VII No. 5, May 1946.

mented preparations of soya bean. A mixtnre such as that successfully used by Mackay might be given a trial. Until investigations along these lines have been carried out, there are insufficient ground for advocating the general use of soya bean 'milk' in infant feeding in this country.'

The growth-promoting property of soya bean milk was tested at Dacca on rats against that of cow's milk using a poor rice diet as a basis. In eight months the rice diet alone produced an increase in weight of 3·44 grams; that diet supplemented with cow milk produced 8·65 grams, and with soya bean milk 7·25 grams. At Coonoor when the bean was given as a supplement to a children's poor rice diet, not only did the children in the basal diet group lose weight but those in the supplementary diet group lost even more. The result of a similar experiment at Lahore was that 'statistical analysis showed that the group receiving soya bean showed no significant advantage, as regards increase in weight, over the group receiving '*dal mash*.' In a series of other experiments the following results were obtained :

1. The average weekly increase in body weight of the rats receiving a supplement of soya bean milk was slightly lower than that on cow's milk, but more than double that on the rice diet alone with no supplement.

2. The group receiving soya bean showed no advantage, in respect of increase in weight, over that receiving black gram.

3. The crude protein content of soya bean is nearly twice that of the other pulses, the 'available' or 'net' protein content of the former was found to be one and a half times to twice that of the latter.

4. Similar results as regards relative biological values were obtained by the growth method, in which young rats were used and protein was supplied at a 10 per cent level of intake.

5. The biological value of soya bean proteins was found to be of the same order as that of the proteins of the other pulses.

6. The addition of soya bean and the other pulses enhanced the growth-promoting effects of the basal rice diet, but the supplementary effect of soya bean was not found to be superior to that of the other pulses. Growth per unit weight of the test consumed was also investigated. The basal rice diet gave the poorest results. The diets containing soya bean were not superior to the other test diets in this respect ; there was some indication that the diet including Bengal gram was more efficiently converted into tissue than the other diets.

7. Although soya bean contains more of fat, minerals, vitamins and available proteins than other pulses, it has, for some unknown reason, not proved itself superior to other pulses within the range of experiments reported here. It is, however, possible that soya bean may, as has been pointed out elsewhere, prove a better supplement than other pulses to typical Indian diets which are quantitatively inadequate and based on cereals. Further work on this aspect is desirable.

The final opinion of the sub-committee is that 'Taking the results obtained so far into consideration, the sub-committee is of the opinion that as a supplement to typical Indian diets based on cereal, but supplied adequate in quantity, soya bean has no special advantage over common Indian pulses.' And 'The sub-committee is not in a position therefore to advocate immediately the encouragement of the production of soya bean on a wide scale in India for use as a substitute for Indian pulses. The question should, however, be reconsidered if and when further evidence on the nutritive value of soya bean becomes available.'

The position for the time being appears to be fairly clear as far as India is concerned where the use of food for industrial purposes cannot be contemplated. It is that the value of soya bean can be measured by its yield per acre against that of other pulses and that it is a poor milk substitute but a valuable addition to a deficient milk supply. In the latter respect it somewhat resembles the position of *vanaspati* with regard to *ghee*—both soya bean and *vanaspati* must be used to augment a deficient supply of a superior article while neither can be a substitute for it.

WHERE AUSTRALIAN WOOL WENT

In the season 1945-46, Australian Wool sales totalled 5,124,000 bales Sales were as follows :—

United Kingdom	...	1,393,000 bales
U. S. A.	...	1,300,000 ,,
France	...	771,000 ,,
Dominions	...	524,000 ,,
U. N. R. R. A.	...	318,000 ,,
Belgium	...	313,000 ,,
Italy	...	137,000 ,,
Canada	...	74,000 ,,
Scandanavia	...	63,000 ,,
Middle East, Palestine and Turkey	...	56,000 ,,
Various European countries	...	42,000 ,,
Mexico	...	33,000 ,,
Denmark and Holland	...	26,000 ,,
Germany (Government a/c)	...	23,000 ,,
India and China	...	18,000 ,,
Switzerland	...	16,000 ,,
Spain and Portugal	...	9,000 ,,
Brazil	...	1,000 ,,

During the same period, South Africa sold 1,687,000 bales of wool and New Zealand 1,365,000.

—Agricultural Newsletter,
Release No. AGN/140.
21-11-1946.

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MORE FOOD FOR *ALL*

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Volkart Brothers supply and service International Harvester Co's (I.H.C.) Tractors and all implements necessary for the clearing and levelling of land, for bunding and ditching and for the eradication of noxious weeds. With Tractors all these operations can be done efficiently and quickly irrespective of seasonal labour shortages. Under present conditions only a limited number of "International Harvester" Tractors can be brought to India. Landholders who wish to employ tractors for more efficient farming, are advised to write to Volkart Brothers *without delay* stating their full name and address, the size of their estate, the crops grown and soil conditions.

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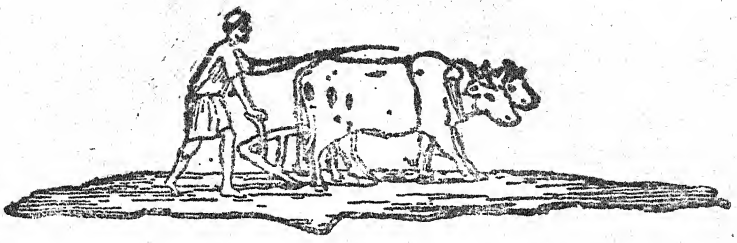

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Editorial

You will find in this number of the Allahabad Farmer an article entitled "Distinguished Agricultural Scientist Retires."

There are three reasons which lead us to publish this article *in the Farmer*: First, Professor Watt is a very competent man who has made a fine career of service to agriculture, Second, we believe it is well for us to recognize that the fraternity of those who are serving agriculture is as wide as the earth. Third, we would like to encourage the preparation of similar articles on the lifetime achievements of Indians who have devoted themselves to agricultural study and service.

This is not the first generation in which agriculture has furnished scope for distinguished careers. Agricultural improvement in Germany and in England was greatly strengthened by capable men who devoted their lives to study of agricultural problems, and who are rightly remembered for contributions which they made as much as two hundred years ago But our generation does show far more examples of such careers. Among the thousands of men who are contributing by careful study of particular agricultural problems, only a few ever receive just recognition.

This account of the life services of Professor Watt serves to give credit to a man of great ability who has devoted his life to the service of farming people.

He was born in Kilmarnock, Scotland. He was educated in England and in South Africa. He worked out his career in Australia. A few men are fortunate enough to be able to move between countries in this way in line of their careers, but even the man who spends his life-time in a single place in a career in agricultural science may today have an influence on farming practices clear around the world. It is significant that Professor Watt sent his associate Mr. Waterhouse to England and America to prepare himself for developing a rust-resistant wheat for Australia. The agricultural scientist today works with data and results of experiments which come from colleagues in all parts of the world, and his achievements in turn help agricultural scientists in other countries.

Most of all, we publish this article in the hope that it may encourage the writing of similar articles about men who have made great contributions to Indian agriculture. This country has, and has had, many of them. A number of significant contributions have come from agricultural scientists in India. *The Allahabad Farmer* will welcome well written articles telling the life story of men who have served agriculture in India, and who stand as examples to young men now entering agricultural careers.

AGRICULTURE—THE BACKBONE OF PROGRESS.*

BY

JOHN L. GOHEEN, LL.D.

In these talks dealing with "Slogans for Progress" Agriculture is considered to be the foundation or backbone of Progress. In other words, Progress depends upon the success of Agriculture and I believe we will all agree that there is solid truth in such a statement. Recent famine and consequent ill-health, even starvation, are poignant memories. The present food shortages in many areas of the world, undoubtedly, are brakes on the wheels of Progress.

Let us stop to examine what we mean by Progress. One eminent authority states, "Progress may be regarded as achievement in the direction of more complete and universal development of human personality." That definition to my mind is satisfactory because it represents achievement in advancing stages in the development of human personality. After one stage is reached, we are not satisfied but press on to attempt to reach the next stage, and so on.

The fact that human beings the world over depend upon agriculture for food, clothing, shelter and certain other amenities of life is so self evident that it hardly needs to be mentioned, and yet it is incumbent upon us to take note of this direct relationship between agriculture and the development of human personality.

For instance, recent scientific investigations have conclusively shown that malnutrition can be and often is not only the cause of stunted physical development in human beings, but even more it can be and often is the direct cause of unstable mental or nervous development, so much so that improvement in mental as well as physical condition can be is (effected) by furnishing those nutrients which have been lacking in the diet of the persons concerned. This subject of nutrition is indeed so important in the well-balanced development of human personality that it is strange that the matter has not received greater recognition long ago

Because of the food shortages already mentioned, the question of balance diets with proper nutritive foods is of course becoming more important every day. Therefore, it is absolutely essential that if advanced stages in human development are to be reached human beings must have adequate food well-balanced in its content, suitable both for the development of brain and brawn. Without such diets progress in the sense in which it is here discussed cannot be achieved. By agriculture in this talk we include the production of both crops and livestock on or from the soil. In fact, every living thing on this earth is dependent in some way or other upon the soil. Agriculture, therefore, deals not only with crops and different forms of livestock, but it has to do with that most valuable of all commodities, namely, the soil. How common a fact that is, so common that we think little or nothing about it, until perhaps agricultural land is alienated in the legal sense, that is, it is taken away from agricultural purposes for residential or business purposes. In that case there often is a special tax placed upon the land to be thus alienated. Why the tax? Because the land no longer will be used for agriculture.

The point is that one cannot construct a building whether for residence or business purposes without doing so upon some piece of land, land which otherwise could probably be used for agricultural purposes, especially in areas of good soil such as the Gangetic plain. Human beings are thus dependent upon the soil because dependent upon the agriculture which feeds, clothes and houses them, and gives them work to do of one sort or another. How extremely valuable then the soil is and how important it is that it be carefully guarded and in no sense wasted or allowed to disappear out of men's control!

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* An address delivered over all-India Radio, Lucknow Station, on April 29, 1947.

It should be evident from this definition of agriculture that it is the backbone of pr gress It may be said to sustain the frame work of progress. Progress is dependent on it. The jelly-fish does not have any backbone. It is entirely dependent on its environment and must make progress forwards or backwards as the currents of the ocean indicate. We do not think of personality in connection with the jelly-fish. On the other hand, human beings who have backbones are able to stand erect, to move about at will, look forward and upward and to win the mastery often times over the most difficult circumstances. However, for them progress would be impossible were it not for the backbone which they possess.

This talk, therefore, is a plea for the greater development of agriculture, both for the sake of the food, clothing, shelter and many of the other amenities of life which depend upon it; but even more it is a plea for the flesh and blood farmers who after all are the living backbone of any country. In fact, I am chiefly concerned that the cultivators receive every form of practical help and sympathetic enlightenment in order that their work may constantly be attaining achievement in ever advancing stages. Without such encouragement and enlightenment it is difficult to see how these cultivators can go forward, can produce more, whether in food and fibre crops, improved livestock or crops having special each or economic value.

By encouragement I mean that they should be given a just reward for the long hours of toil which they spend in tilling the soil and caring for livestock. They should be encouraged by being given the opportunity to live on a higher and more satisfactory plane, and along with that they should also receive such enlightenment as will open their eyes to the possibilities of their reaching themselves advanced stages in the development of their own human personality.

I plead for the youth especially of rural India—those who are to produce in the future from the soil crops and livestock. Now is the time to reach them with such education and visions of better living and better farming as will enable them to see that life in the villages of new India need not be sheer drudgery, but that it may have in it for them and their families, and for their children to be born in the years ahead, a larger measure of happiness and of satisfaction then their forefathers or their parents before them have ever known.

It is significant to note that agricultural education in the higher stages is attracting to it large number of young people, most of whom have no rural or agricultural background whatsoever. These young people may become the research experts, teachers of the various agricultural sciences and whitecollar workers in the precincts of the mighty in agriculture. No criticism should be made of their sincere desire to become experts in these various phases of agricultural science. In fact, this desire is commendable. Their number is increasing year by year, so much so that it is difficult for the agricultural colleges to receive more than a mere fraction of those who apply.

However, my plea is more on behalf of the rural youth who may not have the advantages of primary, middle and high school education and yet who are the actual producers in the business of agriculture. These boys and girls should not be longer neglected. They should receive such (basic) education and on top of it such specialized training of a practical yet interesting character as will stimulate them to take a more intelligent interest in the future of agriculture. They know little or nothing of the elementary problems of seed selection, of the proper conservation of manure and compost material, of the essential principles of animal husbandry, of the budding and grafting of fruit trees, or of what may be called diversified farming. No, their lot from the day they start

to herd goats or cattle until old age cripples them with arthritis or rheumatism, is one of drab, uninteresting routine enlivened only by times of festival, wedding or perhaps funeral.

These young people need not have highly expensive agricultural schools, but there might be something for them in the fair months of the year under the spreading neem or mango tree in the form of question and answer on the subject of seed selection, how to improve live stock, how to improve the soil, conserve the moisture in it and produce more from it, how to read simple literature telling about these new things in agriculture, etc. At night simple cinema scenes or visual education through magic lantern slides, bringing the vision of enlightenment directly home to these young boys and girls and their elders could be arranged. There are innumerable subjects that can be touched upon

As radio penetrates into the rural areas it too through dialogues humourously yet educationally delivered; the recounting of agricultural advance in the neighbouring villages and, thus stimulating interest in that particular advance in that village; the use of lectures, music and various forms of entertainment to greater effect in reaching both young and old with the message of better living and better farming all these forms of enlightenment can be most effectively used.

Thus it is that new life needs to be injected literally as well as figuratively into the backbone of agriculture, that is, into the thinking and the doing of the rising generation in rural India. This injection of new life is absolutely essential. It should be full of those vitamins which will arouse, inspire and enthuse, the youth of rural India to attempt greater things in agriculture than their forefathers have ever dreamed of.

To be sure there are plenty of young people in the rural areas who will not be interested by the challenge of agriculture. They will be attracted by the challenge for the development of rural industries, rural electrification, communications, rural housing, rural education, rural health and the multitudes of other problems connected with rural life. All these things must move forward together hand in hand with the best of cooperation. That means good planning, good education and preparation for the days ahead if the backbone is to become strong enough to sustain the advances in economic and social progress such as will bring humanity on to advancing stages of achievement.

The inertia of ignorance, ill-health, indifference, indebtedness—all of which are brakes on the wheels of progress—must be removed as promptly as possible. In place of such intertia there should be established a condition of rural life which will insure healthy physical growth, mental alertness, economic security, social and spiritual wellbeing, in short, the joy and satisfaction of living well, simply, yet contentedly and with pride in one's profession.

I believe you will agree with me that agriculture in this concept is not only the backbone or progress, but that the agricultural people are truly those who furnish that backbone in flesh and blood and who, therefore, themselves are entitled to develop their backbones to the strongest possible extent.

THE FOOD SITUATION IN INDIA*

By

MASON VAUGH.

The food situation in India has been much discussed in recent months and years. The Bengal famine resulted in large scale deaths by starvation; acute scarcity prevailed in South India, particularly in Madras, in 1945-46. Food rationing begun during the war has been continued and extended to additional areas. Large scale imports have been carried out of food gains and we are told that they are still inadequate and that they have been enough only to barely avoid the breakdown of rationing. Instead of increasing rations, it has been necessary to either maintain or decrease the per person allotment. The most optimistic official view seems to be that the present scale can be maintained. Little hope is offered of discontinuing rationing.

Various explanations have been offered, the war, adverse weather, influx of foreign troops, export of food grains, hoarding, increase of population Undoubtedly, all of these have had some share in the effect. Export of grain in recent years has been officially denied and probably is not an important factor at present. Increase in population has also been denied by many public men as being a factor and figures have been cited to prove that it is not an important factor.

Discussion has centered around the present situation and what can be done about it. Little has appeared in the public press about the trend and what can be expected in that next few years or decades. It seems to be generally accepted that minor palliative measures acting with expected developments will cure the situation and that there is little need to worry about the long range situation. The author believes that this is wrong and that there is grave need for a long range programme looking to the situation 25 to 50 years hence if acute distress and probably large scale famine is to be everted. There seems reason to doubt that even the best planning and action possible can now avert acute distress and possibly widespread famine unless large scale epidemic intervene.

Let us accept that the causes listed above have all entered into the picture; except for the increase in population, they are temporary and have or will disappear with more settled conditions. What is the population situation and what needs to be or can be done about it?

It is admitted and proven by census figures that the population has increased and that the increase is continuing at a very high rate, currently estimated at about 5 million annually. The population has doubled in less than a century; estimates are that it will increase from the present 400 million to 600 million by 1970 and to 800 million by about 2,000. A.D. These figures are discounted on the following bases: The percentage rate of increase has been less in India than in other countries, England for instance; Production of food can be increased by (*a*) bringing new land under cultivation and (*b*) by increasing acre yields; Industrialization will slow down the population increase, so we need not sorry about it. Let us consider these statements.

The percentage increase in other countries is irrelevent unless we consider where the other countries started from as compared with India and their resources. The important thing is not what the percentage increase is but the relation of the population now to the present food supply and the relation of expected population in the future to expected or possible food supply. India is now definitely a deficit country in food production. There are few remaining surplus areas in India. The huge scale of imports needed to balance even the current low diet demand demonstrates this to be true. India is at present very poorly fed both as to quantity and as to quality of food. There is little if any room to reduce the present standard of food to balance the deficit.

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*First presented to the Progressive Club, Allahabad, February, 1947.

What about increasing production? Admittedly, there is land not now cultivated which can be brought under cultivation. The "Bombay Plan" cites figures to show that roughly a 40% increase in cultivated area is possible, according to census figures. It also expresses doubt about whether the land supposed to be culturable waste is really all fit for cultivation. Certainly, while there is some good land lying idle. Much of the reclaimable culturable waste is marginal land, poor in fertility, subject to erosion, a thin, with rock close to the surface or otherwise not of high quality. On the basis of present cultivation methods, much of it will not pay even the present returns or other land for its working and bringing it all into cultivation would in all probability add not 40% to the food supply but possibly 20% or 25%. More than that is needed to raise the standard of food for the present population to a decent level. This does not seems to furnish any means therefore of caring for a larger population on a *decent* level.

The possibility of increasing the production per acre is somewhat more hopeful. Present acre yields on the average are low. Climatic conditions are favourable to good growth and it should be possible to raise the average yields to much higher levels. This will require better cultivation methods, better implements, more manures and fertilisers. On the basis of present knowlege, it should be possible to raise the average yield for the country as a whole to something near twice the present yields. This, however, will take a long time to accomplish. The manure and fertiliser is not available and probably cannot be made available to do it in a short time. Even with the best publicity methods, it will take a long time to reach and teach the whole of the farming population. The increase can only be secured by a complete change in the implements in use. Even with greatly accelerated manufacture, it will take a long time to replace the present implements. This should be done as rapidly as possible, even though it is recognised that it will take time. While I believe that increase in acre yields is the most single hopeful means of increasing the food supply, I am doubtful whether the rate possible will keep pace with the present rate of increase in population, to maintain the present standard of food supply, without allowing anything for improving the present unsatisfactory situation.

A note of warning may not be out of place about the possibility of irrigation solving the problem. Irrigation is certainly a useful tool in the hands of the farmer. It increases the range of things he can do; it gives increased freedom as to time and manner of doing them; *when applied to virgin land of high fertility in arid regions*, it leads to phenomenal increases in yield. When applied to old cultivated land of low fertility, *irrigation alone* may give little or no increase in yield. It is also doubtful whether there is water available for any very large scale extension of general irrigation. Undoubtedly, there is the possibility of increased irrigation of small areas for special crops and this should be used to the fullest extent possible. We should not, however, be complacent about the situation being saved rather simply by a large scale extension of irrigation.

Mechanisation of agriculture is often suggested as a way of increasing food supply both by increasing yields and by releasing food consumed by animals. At present, work animals are not commonly fed foods which can be consumed directly by people. Substitution of mechanical power would, therefore, not result in releasing grain in the way it has in Western countries. Some roughage is produced incidental to the production of grain. Carefully conserved, this roughage will largely support the work cattle needed to do the work if superfluous animals are eliminated. If the work animals are females, some milk can be produced and at the end of their productive period for milk or work they would still be available for meat. At this time, it does not appear that mechanization would either largely increase production or release large quantities of grain. It

will, undoubtedly, be hopeful in reclaiming certain land not at present cultivated. Mechanical power will certainly be useful for certain work which cannot be done by cattle, mostly stationery operations. Adequate experimentation should certainly be carried out to see whether it will really offer extensive advantages or not; it does not seem to me to be an important factor in improving the cultivation of the land now in the hands of and cultivated by the ordinary farmer.

Large scale migration has been occasionally suggested as a means of relieving pressure on the land in India. Aside from any consideration of the attitude of rations now having lower populations, the sheer job of moving and resettling the required number to make any impression of the Indian situation is unmanageable. To keep the population in India stationary by moving out the excess of births over deaths would mean handling 5,000,000 a year. The total available shipping in the word could not handle that many passsengers on anything but army transport standards.

Migration has been a means of filling up empty lands in the past; it has never contributed very largely to the easing of population pressure on land over any very long time. Relatively minor, but actually fairly large scale resettlement may be desirable as a means of developing areas in India which are not now under excessive pressure and at the same time easing temporarily the pressure on the areas worst crowded now. This can at best be only a very temporary and ineffective expedient in so far as the long time solution of the problem is concerned. Removal of a few from one locality to another will only result in their places being taken by new additions to the population continuing to be produced.

When faced with the above facts, many complacently take refuge in the idea that India is due to be industrialized and that the simple fact of industrialization will automatically lead to a reduction in the population growth—"It always has in other countries." It is true that some of the highly industrialised countries in recent decades have had a slowing up of the rate of population increase. This has been at best a rather delayed reaction to industrialisation, even if it can be demonstrated to be directly connected with industrialisation. I have not seen the connection demonstrated. There is reason to doubt whether the same effect will occur in India; such things are governed by complex and not fully understood factors that involve religious beliefs and other factors which may profoundly modify the results in India as compared with what they are in other countries.

Even if we concede that industrialisation will eventually lead to a slowing down of the birth rate and so to a decline in the rate of population increase, the question still remains whether it will operate fast enough to control the situation. World experience in the past is not a basis for hope. It is precisely during the period of industrialisation that there has been an explosive increase in world population. During the past century when industrialisation has proceeded fastest, world population has also proceeded to increase faster than ever before. It took nearly or quite a century for the slowing down effect of industrialisation to begin to appear in western countries. Has India a century of margin to spare—or even half a century? It seems very doubtful to me whether India has *any* margin, whether she can provide a high standard of living for much if any larger population than she now has. There is no reason to expect that development of industry proportional to population, will be more rapid in India than it has been in the West. There is also no reason to believe that it will affect the desire of people for large families any faster in India than it has in the west. I am not opposing industrialisation; I believe in it whole heartedly as being necessary to the development of a higher standard of living in India. I believe that it will come. I do not believe that it will come fast enough to slow up the increase in population in time to avoid extremely difficult conditions.

Up to now, we have assumed that the present trend of increase in population would continue. I do not believe that is a reasonable assumption; I believe rather that we can expect in the next one to two decades a rather sudden rise in the rate of increase. In the past, increase in population has resulted from a decrease in death rate in India rather than from an increase in births. The ratio of births per thousand has not greatly changed. Life expectancy in India is hardly half that of western countries. Malaria is both the great killer and the great enervator. New insecticides, D. D. T. and Cammexane for instance, may well bring the malaria carrying mosquito under control in 10 years. Even if they do not, increased supplies of quinine plus abundant and cheap supplies of stabrin, mopacrin and related compounds may eliminate malaria as a major disease. The new insecticides plus new rat poisons, "Antu" and "1080" could eliminate plague and many other insect borne disease. Better sanitation plus screening could well eliminate such diseases as cholera and typhoid as major diseases. We now have the medical and sanitary knowledge necessary to double the life span in India and there is every reason to believe that this knowledge will be widely applied. If the life span were doubled, unmodified by other changes, we would not only have the growth in population due to the reduction in deaths per thousand, but it would likely be increased by the greater number of people of child bearing age remaining alive; not only would the average family live longer, but the family would be larger.

It seems likely to me that not only will the present rate of increase continue long enough to possibly double the present population before the increase would be slowed down by the operation of the factors connected with industrialisation, but that the rate of increase is likely to be so greatly accelarated that the doubling of the population may come much sooner than is indicated by present trends.

I am told that I am unduly pessimistic, that ways have always been found before to avoid dire predictions of over population. Even if only half of what I have envisaged above should happen, we would need to do everything possible to avoid dire famine in the next few decades. The present situation, unhappy as it is, can be handled somehow. To handle the coming situation will necessitate our taking all possible steps not only to increase production but to cut down unnecessary consumption and to reduce the birth rate to correspond to decreasing death rates.

Some of the concrete steps that might be taken to limit population growth are the following :

(*a*) Publicise the facts so that the public will know what the situation is. The public is not likely to take steps themselves or to co-operate in measures advocated unless they understand what is happening and why.

(*b*) Publicise the necessity for birth control. This is a controvertial subject on which there is intense religious feeling. Perhaps it would be wise to make the need for reduction in average size of family known and to encourage religious leaders to develop and publicise within their own community ways of limiting the size of the family consistent with their community's views. The first necessity is the conviction that limitation of size of family is necessary.

(*c*) Delay marriages. Much more stringent legal restraint on early or child marriages will be needed in addition to extension of schooling and education in the need for limitation of families.

The following suggestive, but not complete list indicates things which might be done to increase the available food supply :

(*a*) Intensify the present agricultural programmes, not only on the research side which should not be neglected, but on the publicity side as well. We should get present knowledge into use as well as get new knowledge.

(*b*) Greater attention might be given to the analysis and study of farming *practices* : as well as of crops. We should give greater attention to helping the farmer work out a system of farming which will give him the best results in crops produced as well as in money profit.

(*c*) Closely related to the above is the need for greater diversification of crops the increase of crops which improve the nutrition value of food available, which give larger quantities of food per acre or which improve the soil for the benefit of later crops.

(*d*) Intensive education to substitute vegetables for grain in the diet. Many in India have never experienced the fact that it is possible to have a meal that is not only nutritious but satisfying from vegetables alone without the use of any grain.

(*e*) Encourage the growing of vegetables by families for their own use in addition to the growing of vegetables for the market. In addition to the vegetables which require water for irrigation. It is often possible to raise substantial amounts of certain vegetables on even very small areas during the rains. One or two *lauki* plants or three or four des bean plants can be accommodated in most courtyards. Allowed to grow up over the roof, they may add substantial amounts of food to the family dietary.

(*f*) Drastic reduction of and limitation of the cattle population. Reduction of the number of animals maintained is the most effective way available for increasing the supply of fodder and feed for the remaining animals. One pair of work animals for 15 acres of ordinary cultivation or one pair for ten acres of intensive cultivation is ample if improved implements are used The use of females as is done in some provinces of India would provide for reproduction. It may be desirable to put legal restraint on the keeping of any non-productive animal. Prohibition of the keeping of low producing cows not used for work, the limitation of the number of animals kept in relation to area cultivated, the compulsory castration of males not kept specifically for breeding, may be desirable measures.

(*g*) Elimination of the monkey menace is essential. Large amounts of grain and fruit are destroyed annually by monkeys. Their presence in certain areas makes impossible the growing of fruit and vegetables which would otherwise be easily produced and valuable. The combination of saving of crop now produced with potential increase if they are eliminated would make an important contribution to the food supply.

(*h*) Effective control of rats, mice and other rodents in grain stores and in field along with the affective control of wild pig, jackals, porcupines, and other wild animals would materially increase the available food supply by preventing the destruction they cause annually. India must choose between food for human beings and food for such animals.

(*i*) Effective control of insects in grain stores would save a large amount of food now grown, harvested and stored, but not available for consumption. New insecticides previously referred to along with those already in use can make this saving possible.

So what are our conlusions? Is India doomed to a long series of famines or epidemics to keep the population within the limits of what can be fed?

The public has not yet been told what the real situation is. Officials have either ignored or in general denied its existence. The present situation may possibly be handled, if we could be assured that the population will not greatly increase. Unless we frankly face the fact that India now has more people than she is able to now feed adequately and that with all the improvements possible, she cannot feed a very much larger number to any adequate standard of nutrition; I believe that nothing but a widespread epidemic of disease on a very large scale can prevent prolonged and severe famine in the fairly near future. Even if we take all the possible measures to limit the population increase and to increase the food supply, there is doubt about whether the fundamental change necessary in the thinking and the actions of the people can be brought about in the time we have before the situation gets entirely out of hand. The situation is grave. It calls for energetic and effective measures. Failure to take them vigorously and with full knowledge of what is involved can only led to prolonged famine, misery and the social and political upheavals which are associated with such conditions.

Notes.

No attempt has been made to document the above paper. For those who wish to go into the matter more thoroughly or wish to verify the author's conclusions by comparison with the writings of others, the following are suggested:

1. A Food plan for India, with a Foreword by Prof. A. V. Hill, issued under the Auspicies of the Royal Institute of International Affairs. Published by the Oxford University Press.

2. "The Food Supply" by Prof. Radhakamal Mukerjee, Oxford Pamphlets on Indian Affairs, No. 8, Oxford University Press, Annas 6.

3. The land and its Problems, by Sir T. Vijayaraghavacharya, Oxford Pamphlets on Indian Affairs, Oxford University Press.

4. "The Agrarian Stuation in India," by Dr. P. J. Thomas, International Labour Review, Vol. I, No. 4, October, 1944. May be consulted in libraries.

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A SUGGESTION TO CO-OPERATIVE MILK UNIONS*

By

P. K. Bhargava, B.Sc., B.Sc. (Ag.)

India is a country where the majority of population is purely vegetarian and in its main diet the source of first class protein is from milk and its products. According to several foreign experts, it has been declared that the diet of the bulk of population of this country is lacking in protein. They have suggested that the Indian diet should include at least 15 to 16 ozs of milk (Wright) and the price of milk should be brought to such a level that the poor can afford to have the necessary minimum quantity of it in the diet. This can be done only by the increase of production of milk per head of milk producing cattle. But in the present state of affairs in our country we are having a supply of only 750,000,000 maunds of milk, out of which one-third only is used as fluid milk and the rest is converted into milk products and that also reserves 75% of it for the manufacture of ghee which is beyond the reach of an ordinary labourer. The problem before us is, therefore, how to raise the quantity and the consumption of more fluid milk. This problem can be tackled a little by tapping the rural population where the most of the fluid milk is converted into ghee or is run into separators which are fixed up by the middle-men in the rural area.

The creation of the few cooperative milk unions that we have is encouraging as their duty is to collect the rural milk and make it available to the urban areas and put thereby in the pocket of cultivators a little more money than what they would have got by converting the same into ghee. But this system of co-operation in the collection of milk is not perfect and has several serious defects of its own.

If the co-operative milk unions are compared to the middle men, we find not much difference between the two, except that one is a joint association, while the other is an individual concern. The main object of the Co-operative Unions is to get the milk from the cultivators on a cheaper price and sell it to the consumers in the urban areas on a reasonable price, and then to assist the members of the society they give some facilities to them in terms of loan, and the supply of feed (only cake) and sometimes of animals. But these facilities are not much in favour of the cattle of the village though they are, to some extent, to the gain of the cultivators. The reason is obvious. Cultivators are not given encouragement to pay enough attention towards the feeding, the breeding and the management of cattle. These concerns are neglecting this side, which results in the deterioration of village cattle in health and performance. Our cultivators take a hereditary right to follow blindly their ancestors' rules and do what they did. They pay more attention to their bullocks than cows. The cows in the villages are reared more for the bullocks than for the yield of milk. The yield of milk is a secondary factor with them. To bring about a radical change in the view of the cultivators so that they may look upon the yield of milk as their primary concern is the call of the day and it is hightime that the Co-operative Milk Unions responded to it.

These unions should play a greater role in the improvement of village cattle in health and performance, and for this they should pay attention to the principle which is accepted all over the world that feeding, breeding and management are the three most important factors which go to improve any breed in any country.

FEEDING:—It is a glaring fact that the majority of our village cattle are seriously underfed. This is apparent from their outward appearance, slow rate of growth, the late maturity and long dry period. The village cow drops her first calf when she is of 4 to 5 years of age and the life of a cow is only 10 to 12 years so we can easily see that she would hardly produce 2 to 3 calves in her life-time

* Particularly in United Provinces.

and thus the productions of milk would also be down. But it has been proved experimentally that our Indian dairy cattle in village conditions are not very poor in milk genes as they appear to be. It is quite significant that a village cow produce 60% more milk if she is better fed. The better feeding itself would bring about the increased yield of milk from the same number of cattle by 60% more than what is produced now. The problem is how to start. The fodder situation of our country is also not encouraging as the supply is not able to provide the required amount of digestible nutrients. In the villages the cattle are fed with 'Bhusa' with the addition of a little cake which some times is also not available. In other words the cattle are fed on poor rations which are lacking mostly one or other nutrients. Co-operative Milk Unions have attempted to solve this problem by supplying a little quantity of cakes. The supply of cakes alone will not altogether solve the problem and there are reasons for it. Firstly, the cows will not get the cake which have been supplied to the cultivator because the cultivator is more interested in his bullocks than cows and young stock. So there is every possibility that all of the cakes may go to the bullocks leaving the cow and particularly the growing stock starved. Secondly, the cake alone does not supply all the protein and other required amino acids conducive to the growth and the production of milk. It is always wise to give the animal a variety of feed for the supply or protein.

The suggestion I would make for the better feeding of the village cattle is to feed the cattle with a balanced ration. This ration should be given to the milking cows at the time of milking. The milking of the animals should be done jointly at the societies' milking sheds. The supervisor in charge should see that the required amount of rations is fed to the cows before milking. The quantity to be supplied to the cows will be decided by experience, but I think that a ration having a N. R of 1 : 4 can be supplied to the cow and this should be half the quantity of the total milk she produces in a day. This balanced ration would also take care of the poor quality of roughages which are generally fed in the village. For the growing stock the cultivator may be persuaded to purchase the fixed amount every day from the store. By this method the cultivators will not have to be worried for the concentrates and, moreover, it would not also be waste in certain cases where the money is the limiting factor; *i.e.*, on the one hand, cows are given inadequate quantities of food, while, on the other, those who can afford to purchase can feed their animals frequently as much as 50% in excess of requirements.

Again, the animals should also be rationed according to their capacities of performance and for this the Government should help the poor cultivators in providing the food right in quantity and in quality, which so far our cattle are not getting. The cost of the feed can be realised from the sale of the milk which they have supplied to the union. The cost of the concentrate will be depending on the availability of the feed and the efficiency of the person who balances it. Let us assume that a certain union is collecting 30 maunds of milk per day. The amount of feed according to recommendations would be about 15 maunds of concentrate. The union is purchasing milk at 4 seers per rupee and, therefore, the total cost of the milk would be Rs. 300, whereas the cost of 15 maunds of feed would be Rs. 75 at Rs. 5 per maund (on dairy farm) which may be considered rather a little high figure, but it can be made less also. The cultivators would be getting (Rs. 300—75)—Rs. 225 as the cost of milk after deducting the cost of feed which I think, is a fair price.

From the nutrition point of view the quality of the conc. (feed) will be raised to a greater extent in comparison to the cakes alone as the source of protein.

Now comes the question as to how to get the feed stuff in such a bulk for distribution. It can be suggested that the Government should help the union in getting their required quota on control prices, as it is done in the case of cakes.

The financing can be done by the co-operative banks which can charge a reasonable interest on the sum invested. This all together would take care of the purchase of the feed.

BREEDING:—The next stage in the improvement of village cattle is the breeding. Next to feeding breeding plays an important part, because feeding can take care of the present animals, but the breeding will be affecting the future generation. The U. P. Government has been distributing the "good bulls" to the villages for the improvement of cattle in the villages. The Government has been purchasing large number of bulls from the reliable dairy or breeding farm on high prices and selling them to the villages on Rs. 30 each with a bond of guarantee. By this method I do not know how much improvement has been attained in the uplift of the village cattle, but to me it seems that very little good has been done to the village cattle. There are reasons behind it. Firstly, the Government is not able to distribute the bulls according to the demand. Secondly, the bulls purchased are of inferior quality and thus some of them have no pedigree at all. Thirdly, the bulls supplied in the villages are not properly cared for. All these three factors together give us a very gloomy picture of the method adopted by the Government. This is simply an eye wash to gain the favour of cultivators or to keep the people of the department busy about something.

The same process is also followed by the co-operative societies because they have to depend upon the mutual help of the Animal Husbandry Department. But I am fully convinced that the breeding of problem can be solved better by the introduction of Artificial insemination. The Co-operative Milk Unions should purchase bulls from the renowned and reliable farms where the record of detailed pedigree may be available. They should not depend much on the pedigree, but should combine the pedigree with its type. If possible, the aim should be to get the proved sire. The price of these bulls may be tremendously high. But it is also clear unless and until you pay the better price to the breeders, you can not get the genuine stuff. This would be rather a kind of encouragement for the breeders and they would try to breed the best for the sake of price and demand.

The Union will have to maintain the bull at its own responsibility. The feeding and breeding will be done by the Union on the nominal payment If it is left with the members of the society, it would also have the same fate as the other bulls have at present. The union centre should be equiped with all the possible equipment for collection and insemination to semen.

The selection of the breed of the bull, the breed of the cows in the villages, and the number of the cows in the locality, will be depending on the discretion of the expert. I would suggest that three bulls will be the suitable number in 400 to 600 cows. These bulls should be installed in different centres and thus after every three years these should be moved from one to the other centre. In this way we would be able to save our animals from too much inbreeding. As Lush suggests $1/8\ M + 1/8\ F = \%$ of inbreeding. In the number of males which is indicated by M is more than one then the percentage of inbreeding in the population of the breed is reduced.

The artificial insemination can be carried out by the Supervisor incharge at the centre who can be sent for short training at the Allahabad Agricultural Institute or at Izatnagar.

This procedure would save the Government from spending more money on the distribution of bulls, majority of which are not worth using. Besides, the Government could be able to prove the bull in short time and thus can see the results in quicker time. But this type of procedure can only be successful when all the scrub bulls in the villages are castrated.

To make our idea clear, let us take an example. Suppose we have purchased a proved bull who has 4,000 lbs. of milk, and animate this bull to the village cows who on the average produce 600 to 800 lbs. of milk in a year. The progeny of these would be ranging in the half way of parents, *i. e.*, having about 2,300 to 2,400 lbs. of milk. Then we see that in the next generation the milk has increased from 600 to 2,300 lbs. By this the Union and the villagers both would be benefitted. The increase in the milk from the same centre would reduce the cost of handling the milk and thus it would enable them to sell milk at cheap prices to the customers so that a person of little means would be able to purchase it. On the other hand, the cultivator who till now get only Rs. 30 from the cows would be getting about Rs. 120 per year from the progeny of his cows. Thus there would be 400 per cent increase in his income. This would encourage others to maintain animals of heavy yield and finally the collection of milk from the different villages would yield a place to the collection from different houses in the villages and thus save more of labour and organisation.

The last but not the least important factor is the management. To make the villagers accustomed to this is a difficult task and would take time. For this the Government should help the villager through co-operative unions for the installation of tube wells. Because water is the main factor of sanitation. Most of the cattle in the villages die of thirst and when they do not get clean water, drink from the dirty ponds abounding pathogenic bacteria which effect the cattle and cause their death.

The cultivators should be given regular demonstrations at their doors for developing the knowledge of sanitary conditions. Qualified persons in the villages should tell them of the advantages of cleanliness of cattle. The cattle should be tied in neat and open places instead of inside of the place where the cultivator himself lives. Peppirall has given in his report "Dairy Industry in India" a very gloomy picture of such conditions at Bombay Goshala.

To make the whole practicable it is imperative that the union should select a centre in the population of 100 houses in a village where majority of the people are maintaining cattle. On that basis they should construct the building of the centre and the milking sheds. At the same place they should install the tube well. Then they should persuade villagers to bring their animals in the paddocks where the animals will be tied by the individual owner jointly at one place. The care of these animals will be taken by the owners under the instructions of the supervisor. Besides, that they should be sure of the health of the animals, a veterinary surgeon should be employed by the union to pay regular attention to the animals. Otherwise, in the villages it is very difficult to get the veterinary help. There are not enough trained veterinarians as to extend veterinary help to the villagers. But the Veterinary Surgeon of the Union will not make the cultivators move for individual help, but would bear the union's responsibility to see that the animals are properly cared for.

But there is the job of the Government to help the cultivators through unions for the growing of crops and fodder and preserve the same in silo pits to be used at the time of scarcity. Or, in other words, it should encourage co-operative farming through the Union.

Thus the task of collection of milk from door to door in villages which would otherwise be an expensive means becomes an easy job by developing the villages on co-operative basis for dairy industries, and the Co-operative Milk Unions thereby will do great service to the cultivators and to the country.

DISTINGUISHED AGRICULTURAL SCIENTIST RETIRES.

By

Mary Evans-Jones.

Recently retired after 37 years' service to agricultural science in Australia, Professor Robert Dickie Watt is paying a visit to his native Scotland. His researches have helped considerably towards the defeat of a number of enemies of the Australian farmer, including Bunchy Top, Prickly Pear and Wheat Rust.

Professor Watt has the brow of a scholar, but the large powerful hands of a man of the land. Born and brought up on a dairy farm near Kilmarnock, Ayrshire, he studied Latin and Mathematics at night to enter Glasgow University at the age of 19. He graduated with an M. A. degree, as a Bachelor of Science in agriculture, and with the highly-prized gold medal for first place in the United Kingdom in the National Diploma Examination in Science and Practice of Agriculture. He also won a national diploma in dairying, and was awarded a Carnegie Scholarship. He worked at Rothamsted, Hertfordshire, under the guidance of world-famous Sir Daniel Hall, and spent three years with the Transvaal Department of Agriculture in South Africa before coming to Australia.

When he began his work in Sydney in 1910, agriculture was a department in the Faculty of Science, and he has only four students. Ten years later, agriculture was made a full faculty, and on his retirement at the end of 1946 Professor Watt had 207 students.

He considers training students has been his most important work. Those who have gone through his course include three Rhodes Scholars, and many men who now occupy highly responsible positions both in Australia and overseas. But as well as training students, Professor Watt has directed much invaluable research work in the interests of Australian agriculture.

He first drew attention to the problem of soil erosion in a discussion group in 1913, and was a member of the Australian Council for Scientific and Industrial Research from 1926 to 1942.

In the summer of 1923-24, "bunchy top" attacked banana plantations in northern New South Wales and southern Queensland, where a flourishing industry had grown up. Leaves at the tops of the trees grew small and bunched together, either preventing the fruit from ripening, or killing the trees.

Professor Watt describes the results of this banana diseases as one of the saddest sights he has ever seen; whole plantations were dying out, and people were deserting their properties. No time could be lost in combating this menace, and Professor Watt gave the opportunity to Mr. C. P. McGee, one of his young Sydney graduates A greenhouse laboratory was erected for him in the banana district. Within a year he had found the cause. As Professor Watt had suspected, it was a virus disease transmitted by the banana aphis.

The cure was drastic; every bunchy top tree had to be eliminated, and special sprays were used to guard against further outbreaks. But bananas from this district today bring in a yearly cheque of Rs. 1,07,08,334.

Professor Watt's share in the destruction of the prickly pear pest was another spectacular achievement. Through the introduction of the cactoblastic cactorum caterpillar, Professor Watt and his team of laboratory workers saved 60,000,000 acres of land, from the prickly pear, which had been introduced to Australia as an ornamental plant without any of the natural enemies that kept it within bounds in other countries.

But Professor Watt considers the development of rust-resistant wheat the greatest success he has presided over in the field of agricultural research. He sponsored the appointment of Mr. W. L. Waterhouse, an ex-student of his, as Research Professor in the Faculty of Agriculture 26 years ago, and advised him to visit England and Minnesota (U. S. A.) to study types of wheat grown there. Professor Waterhouse after many years of patient experiment has now produced types of Australian wheat that are not only rust-resistant, but of good quality grain, easy to harvest and drought resistant.

A number of Professor Watt's students have distinguished themselves in the field of science. Dr. A. E. Treloar, Professor of Biometry at the University of Minnesota, U. S. A., is one. He went to the United States in 1926 on a Farrar Memorial Scholarship from Sydney University, and was persuaded to stay as a lecturer at the University of Minnesota. He has remained in America ever since, and has now taken charge of the important Faculty of Biometry, which has become an extremely important subject in experimental work on the application of statistical methods to biological problems.

Other former students of Professor Watt's are Colonel J. K. Murray, Administrator of New Guinea, and his wife, who was a woman graduate in agriculture, also Miss Lorna Byrne of Sydney, pioneer rural sociologist in the New South Wales Department of Agriculture, and Professor McMillan, who succeeds Professor Watt as Dean of the Faculty of Agriculture at Sydney.

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THE PRODUCTION OF HIGH QUALITY BUTTER.

By

James N. Warner.

The quality of butter made in India is commonly rather poor. Much of this butter could be greatly improved if the necessary care were taken in its manufacture and handling. There are several causes for this low quality. Excessive acid in the cream, excessive curd in the finished butter and the absorption by cream or butter of undesirable flavours are the most common. Neglect or lack of knowledge of the proper method of procuring and processing cream and the making and handling of butter usually results in the butter having a low sale value, poor keeping quality, or both.

Deterioration in butter is principally the result of bacterial action. The common types of bacterial action occuring in butter are fermentation and decay. In the former the milk sugar or lactose is changed to milk acid or lactic acid; in the latter, the milk proteins are decomposed. Fermentation produces high acid stale or old flavours in the butter, as well as a high susceptibility to oxidation and hydrolysis which precede rancidity. Proteolysis or decay results in the production of nitrogen, amino acids and 'ammonia substances' which give undersirable odours and bitter flavours. Another rather common defect in butter is a flavour of cow-dung smoke. This, however, can be quite easily prevented.

The addition of some salt to better serves as a preservative by retarding, if not preventing, bacterial action. It dissolves only in the water portion of the butter. Two per cent. of salt added to butter containing 16 per cent. of water produces a concentration of salt in that water equivalent to 2 in 16 or 12½ per cent. Since bacteria grow almost exclusively in the water fraction of the butter, they find such a salt concentration rather high—usually, but not always, too high. In order that the keeping quality of the butter might be improved, salt must not be added in quantities so great that the market value of the butter is reduced. A strong salty flavour is not desired by most consumers.

India's climate does not permit the holding of milk or cream for any appreciable time without spoilage occuring. The village method of holding cream too frequently involves holding it near the boiling temperature, or at least at a simmering temperature, over a drug-cake fire. This does prevent the usual types of bacterial spoilage. It introduces another difficulty, however, which is frequently very pronounced, that is that the dung-smoke flavour enters the cream. Such flavour is carried through from the cream to the butter, greatly reducing its sale value. This defect is as pronounced in fresh butter as butter which has been held for some time; it does not become more intense, nor does it become appreciably less noticeable on storage.

Apart from that produced on well managed diary farms, cream of the best quality can be obtained only by purchasing fluid milk in a village where a separator is maintained. The milk must be immediately separated on removal from the cow and the cream transported at once to the butter factory and churned within the shortest time possible. Nei her the cream nor the milk should be held by heating over a dung-cake fire. Even a wood fire in the open is undesirable. Milk should be separated and the cream delivered two times daily rather than once, in order that the need for holding the milk or cream in the village might be obviated. Reduction of the time between the production of milk and the receipt of cream at the butter factory reduces the need for holding it in the village where it may be reduced in quality by dung-cake smoke. This method of procuring cream will also reduce the likelihood of undue acid development.

Cream should always be pasteurised before it is churned. Pasteurisation is designed specifically to destroy all pathogenic or disease producing bacteria that may be found in milk or cream. Milk may be boiled, as is commonly done by the consumer in this country, without destroying its physical properties, provided the acidity is low. This, however, is not true of butter. Once heat is applied to butter, it undergoes physical changes which result in the formation of ghee. If butter is to be heat-treated to make it bacteriologically *safe*, the heating must be carried out before the cream is churned, not afterwards. It is unwise, unsafe and a dis-service to mankind to sell a product that is to be used for human food if that product is known to be or might possibly be unsafe, that is if it is a carrier of disease producing bacteria. It is imperative that cream be pasteurized.

It may be necessary to neutralize cream before it is pasteurized if the acid content of the cream is high. There are difference of opinion as to what is high acidity in cream. Some authorities state that cream should never the churned if it has an acidity of more than 0·32 per cent expressed as lactic acid. Others give somewhat lower figures, which may be more desirable for this country. The quanty or protein contained in milk or cream will determine the maximum acidity at which one might dare pasteurizing it, without expecting results that are not conducive to good quality butter. If the acid is too high in the cream at the time of pasteurization, the acid-heat combination may result in coagulation of the milk protein, just as it does when poor quality, that is high acid, milk is heated. This results in the formation of large and numerous curd particles in the body of the cream, all of which cannot be removed in the manufacture of butter. Cream pasteurized at too high an acidity will regularly give butter with an excess of curd. Curd contains the non-fat solids of the cream, principally lactose and protein, together with some acid, which serve as food or bacteria that survive pasteurisation or which get into the cream or butter afterwards. It also provides material which may break down chemically, by enzyme action or other means, to produce substances which give butter very undesirable flavours or odours.

Neutralization involves the standardization of the acid of the cream by the addition of an alkali solution. The alkali material used for neutralizing cream is either soda or lime. It is rarely advisable that the acidity of cream

for butter making be reduced to less than 0·15 per cent. but it must be reduced to less than 0,32, preferably less than 0·25 per cent. before desirable results may be expected. Whether the cream is or is not pasteurized, it should not be churned with an unduly high acid content.

The churning temparature is important in the production of high quality butter. If the temperature of the fat at the time of churning is too high, soft greasy butter will result. Such butter tends to retain more of the curd, consequently, it has a poorer keeping quality. The temperature at churning should be such as to prevent this difficulty, yet it should not be so low that the fat becomes too hard to be properly handled. If the fat is too hard, improper working, resulting in improper moisture and salt distribution may occur

The churning time must be carefully controlled to avoid the incorporation of excess curd material in the butter. When butter breaks, as it is churned, the globules of butter fat fuse with each other to produce butter granules The smaller these granules, the less curd material they may enclose. The duration of churning subsequent to the breaking stage determines the size of these granules, since on continued agitation or churning these smaller granules fuse to form larger granules which in turn fuse with each other. This brings about an ever increasing size of the butter granules. The ideal size of granule is stated to vary from that of a juar grain to that of a small pea. Excessive churning may produce granules as large as one to three inches across. The smaller the granules, the greater the surface area per unit of fat exposed for washing, so that, apart from the curd material included within the small butter granules, there is greater opportunity for removing curd material, from the exterior of the granules, by washing.

Butter granules must be thoroughly washed with clean cold water. This removes the curd material not completely enclosed within them. It prevents, thereby, further incorporation of curd material during the subsequent steps in the churning of butter, particularly during working of the butter.

Butter made in this country can be greatly improved in quality by the use of a higher quality cream which is neutralized, if necessary, pasteurized and churned to the desired size of grain or granule at the proper temperature. This must be followed by through washing of the butter granules before they are moderately salted and adequately worked. Butter should, if possible, never be touched by the hands; it should be handled with wooden ladles or parchment paper to avoid contamination subsequent to its manufacture.

"FARMERS OF THE UKRAINE—1946."

By

JOHN STROHM

Kieve, U. S. S. R.—Can this be the Ukraine?

Before the war these green and amber fields were claimed to be the most highly mechanized farm area in the world. Where were the huge crawler tractors you'd seen pictured, pulling giant combines across the limitless vistas of the Soviet breadbasket?

Before me stretched scenes straight out of the Bible. Bare-foot women swung cradles, scythes with a wooden frame to catch the sheared grain stalks. Other women stooped to cut the grain a few straws at a time with sickles. They bound the bundles by hand.

Men and women threshed with a flail, whipping out the grain with a pointed stick.

There were a few reapers, crude contraptions like Cyrus McCormick's No. 1 model, which cut the grain but did not bind it. That again was the job for the stolid Soviet women who gathered the grain, tediously fashioned a tie of twisted straw, and bound it into a bundle.

On one 200-mile jaunt through the heart of the Ukraine you don't see a single combine at work, although the harvest is in full swing. You don't get close enough to a working combine during two months of harvest travel even to get a picture.

Cleaned Out By Nazis

"The Nazis pretty well cleaned us out," said the agronome for the province of Kiev, as we jeeped along the dusty road. He pointed out to a crew of women, there cradles swinging in unison.

"Before the war, 90 per cent of our grain was cut by machine. This year more than half of it will be cut by hand."

The Ukrainian Republic, a little over three times the size of Illinois, lost 24,000 combines and 56,000 tractors, thus forcing the farmer back on the primitive implements they had been steadily discarding since the Revolution.

A team of oxen lumbered by, drawing two drums of fuel for the machine-tractor station. "How much are those oxen worth? I asked, a bit set back at the sight of oxen being hand maidens to tractors.

"They're golden. We lost 90 per cent. of our horses and 80 per cent. of our cattle in this region. So there is no price on oxen, any more than you'd put a price on a loaf of bread you needed to keep from starving."

A farmer and his wife were taking some collective farm produce to market. They were asleep on a clump of hay on the wagon—after all, the horse knew the way. But the horse was obviously no friend of motor vehicles. When we approached, he jumped the ditch, and tipped the cart over. Everywhere I went in the Soviet Union except in Moscow, the horses shied at our car.

Cut Back Trees

My companion pointed to the nearby forest. The Germans had cut all the trees a hundred yards back from the road as protection against being surprised by the Partisans who hid there and ambushed Nazi columns.

"About the only pigs left in the Ukraine are in those forests," he said "Wild pigs—we hunt them with dogs."

The cobblestone road out of Kiev soon gave way to sand and then to dirt—good black dirt any farmer likes to have on his farm, but not on his road or his face. "You will take some of our good Ukrainian soil home with you, yes?" the agronome laughed as our faces became thick with dust.

Piles of rock along the road had been there since before the war. They were just getting around to building the road. He corrected himself. "No, our 'visitors' are going to build the road—they came to the Ukraine, so we're inviting them to stay and we're giving them a job."

The "visitors" were thousands of German prisoners toiling along the road. Some sat and laboriously pulverized the stones with a hammer. Others spread the crushed rock on the road bed. Still others shaped the larger stones for making a cobblestone surface.

Poorly Clothed

Some of the Germans were barefooted, some had rags tied over their feet, and none looked exactly like a conqueror in his ragged uniform. But they were as well dressed as the Russian roads crews.

"How do you feed them?" I asked a road guard, with a tommy gun slung over his shoulder.

"They get the same rations we do," was his answer.

We passed many women with milk and cheese and vegetables slung on shoulder yokes, trudging wearily to market. We saw them lying in the grass by the side of the road, resting, hoping against hope for a truck to come their way.

"Before the war we had buses. Now, if they can't get a ride, they walk. Sometimes 10, sometimes as far as 20 miles to get their produce to market," a Ukrainian told me.

Collective farmer who live near the big city markets can get such fancy prices as $2 a pound for the tomatoes they grow on their private plots or up to $1·25 a quart for milk from their cow, and 50 cents for an egg. But here's the rub: This privately grown produce can be marketed only by the owner—that's to prevent speculation, an official explained. So that's why 25 women will start out at 3 a.m. on the 20-mile hike to market, instead of sending one cartload of produce. And if a collective farm isn't within walking distance of the market, it usually must make some deal with a government agency at a considerably lower price. The Russians need trucks and roads to drive them on, just as American farmers did 30 years ago.

Busy at Work

Everywhere the Ukrainians were busily at work. I was struck with the energetic rural reconstruction. Even at the height of harvest (and sickles take a lot more time and people than combines) new houses were going up in practically every village we visited.

"To replace those burned by the Fascist beasts," one of the builders said.

It's not an uncommon sight in the Ukraine to see community construction like the barn-raising days of early America. The women and girls, their skirts held high, mix great gobs of mud and straw with their feet. The men make a lace network of branches, and then apply the mud—the reinforced concrete idea, but with different materials.

"Is that house painted?" I asked incredulously, because a paint salesman would soon starve in the Soviet Union.

It was a neat white home, thatched with straw. The farm chairman explained it wasn't paint—it was a white clay which they used to whitewash the building. They do it twice a year, and there's a lot of competition between the neighbours. Some villages look as if they had just gone through a paint-up-spruce-up week.

Prettiest Homes

"They tell us we have the prettiest farm homes in the Soviet Union," he said with pride.

The farm chairman invited us to have a "cup of tea." The table was laden with cold meats, cheeses and hardboiled eggs. I didn't even need their polite urgings to eat heartily. Just when I was beginning to feel well-fed, they cleared the table—and brought in the soup, the first course in a collective farm banquet.

On either side of me was a farmer whose instructions must have been to keep my plate well filled. Every time a dish of rasp-berries or boiled potatoes or beef came our way, they pushed half of the contents off on my plate. A long towel rested across our laps, a sort of community napkin.

I stuffed and stuffed and then they brought in the main course—a couple of suckling pigs, shaved and roasted! Somehow I staggered through and finished off with fresh cherries dipped in honey, with salted cucumbers on the side.

They told me: "If you don't like cucumbers, you're not Russian!"

At this "cup of tea," obviously set up for the visitor, the host brought out the inevitable vodka. The farm chairman toasted the friendship of America and the Soviet Union. I toasted the spirit of the women who were doing the job with cradle, sickle hoe, and flail.

Toasts 'Better, Bigger Crop'

The farm agronome, a 27 year-old woman graduate of the agricultural college, was more practical: Her toast: "To a bigger and better crop next year!"

The Ukraine crop wasn't so good this year. Effects of the war are still a big factor because scarcity of machines means poor soil preparation. But that isn't all. One of the biggest bugaboos of the Soviet farmer generally is the unpredictable climate. It is either too hot or too cold, too wet or too dry.

The Ukraine, which we commonly assume as being a black soil paradise, has its troubles. Winds from the Central Asiatic desert periodically play havoc with the crops. One or two "good crop years" out of five is about all they expect. And this was a drouth year.

They thought their grain crop wouldn't be much more than 60 per cent. of normal. The Soviet Union as a whole may get a yield of between 11 and 12 bushels. That's a guess. All Soviet farm statistics are as secret as atomic plans.

Drouth was one reason the Kremlin gave in explaining why bread rationing could not end this year.

Women Swing Cradles.

Two women were swinging cradles in a wheat field. One was barefooted the other wore illfitting men's shoes. Each had to cut 1·1 acres a day to earn a labour-day's work. That kept them busy from dawn until dark, a long day in the Ukraine where in summer it gets light at 3 a.m. and you can still read a newspaper out doors an hour before midnight.

As we chatted the women whetted their blades. I complimented them on the spirit with which they swung their cradles when they didn't have combines, said I was going to tell their story to the women of America.

One of them spoke up. "Then tell them too that we need bread—we don't have enough to eat."

I pointed to the field of ripe grain in surprise.

"Yes, but we don't get any of it," she answered.

The Ukrainian people were more outspoken than any other groups I met. They weren't afraid of an NKVD man listening over their shoulders, as many Russians seemed to be.

(Recent news dispatches tell of a purge among collective farm leaders in the Ukraine. While I was in the Ukraine the newspapers were complaining about the lack of political leadership, pointing out that 7,000 collective farms in the Ukraine had no Komsomol or Young Communist organizations. One said, "We must stuff off the boredom and apathy which prevails.")

Want Increased Yields.

The government is doing all it can to increase crop yields through seed selection stations such as the one at Mironovka where they developed the famous wheat hybrid, Ukrainka.

We visited a machine-tractor station. A few workmen were hewing timbers. Another couple were sawing boards—one on top of the log which rests on a high platform, the other underneath. A rusty crawler tractor sat under the tree.

The enemy had destroyed the machinery it didn't cart off. The MTS saved only 12 of its 68 tractors, and lost all of its 27 combines. It now has 40 tractors in use, keeps them going 20 hours a day.

"In our country we keep tractors working much more than you do in America. Therefore, we don't need so many," the director said defensively.

These machine-tractor stations were established by the government to keep the tools of production concentrated in the hands of the state. Example: A collective farm cannot own a tractor or a combine—only the MTS can own these tools. A collective farmer cannot own a horse, although the farm can.

"How does the MTS work?" I asked the director.

"We are an agency of the Ministry of Agriculture, and we rent our machines to the collective farms. Rent is based on yields."

"For example: If wheat makes nine bushels to the acre, then the charge for plowing the ground is 20 pounds an acre; for seeding, 3·6 pounds; for cutting, nine pounds. But if the wheat makes 25 bushels an acre, the charge for plowing is 135 pounds an acre, for seeding, 22 pounds, and for cutting, 53 pounds."

Rentals Paid in Kind.

All rental fees are paid in kind. The MTS was another method by which the government could insure a steady supply of grain and other food crops coming from the farms to the cities.

Some Americans in Moscow had said, "It's impossible to get into a Russian home" But I visited in several. Once at 10 p.m. after a visit to farms, we were preparing to start the four-hour, 80-mile trip to Kiev. The county chairman insisted that we drop by his home for a brief visit.

He was a Party man, and he had never had "the honour of having Americans visit" his home. It was a pleasant place with electric lights, a piano and many flowers. His wife and attractive 18-year-old daughter brought us fruit compote made of grapes.

He told us his father was a peasant on the estate of a big land-owner before the Revolution, with only 84 square yards of land he could call his own. He had started work in a factory and had joined the party in 1927. He came up through the ranks and was put in charge of 18 collective farms in 1935. Now he had been "elected" chairman of the county and had 41 collective farms, a state farm, and two machine-tractor stations under his direction.

The Ukraine was real booty in the eyes of the Nazis, and they went after it systematically.

"They took the brass doornobs off government buildings, before they burned them," said a Kiev official.

"They stabled horses in the Polish Catholic church," said a priest sadly.

Stripped Bronze.

"They stripped the bronze off the tombs," said a caretaker at the cathedral.

But the old monk, his eyes misty, told the most heart-breaking tale. The Germans tried to peel the gold leaf from the dome of the famous 11th century church. Then, two months after, they had occupied the city of Kiev, they blew up the church.

"Our government has appropriated 26 million rubles (more than two million dollars) for its restoration," the old monk said. "But it can never really be restored."

"My mama works," said little Anna. Many mamas work in the Soviet Union, in the fields, on the roads, in the factories. A casual visitor gets the impression they're doing three-fourths of the work. Their children are kept in nurseries.

Anna was a cute little five years old, who with 125 other boys and girls stayed in this nursery from seven in the morning to seven at night. The children, from three and-a-half to seven years old, are then picked up by their parents on their way home. That is, all but 60 of them—60 of them lost one or both parents in the war. Parents pay on a sliding scale—according to their salaries.

Eat Under Trees

Small groups were eating at little tables under the trees. "Dobredin!" (Good day) they chorused when they saw us—and without prompting. One forlorn little fellow was eating by himself.

He was being punished one of the little boys informed us. "He spit on Pavel."

The boys were making a big battleship in sand. Its name, "Stalin." Others were building footstools of wood, using hammers or even wooden blocks to pound. "The Germans took most of our tools," the director explained.

Each child has his own little corner of the garden to weed and to water. On the shower bath walls were colour illustrations of Little Red Riding Hood and the Three Little Pigs.

The woman director took us upstairs. She wanted us to see one of the nursery rooms. There on the walls were stork and animal pictures painted in gay colours. But German soldiers had scrawled lewd drawings of nudes among the storks.

Car Breaks Down.

On the way home from an auto trip into the country, our car, a liberated German sedan made for the Hitler autobahns, broke down on the bumpy road. While the chauffeurs fixed it, we sat on the bank. I coaxed a 12 years old boy to come over, and to hold his attention. I tossed a knife in the air to show him a game I had played as a kid—mumble-peg, we called it. The knife did not stick in the ground.

Quickly and naturally, the boy picked up the knife and went through the entire mumble-peg routine. I had learned it at a one-room country school in Illinois. He even had some variations I'll bet our kids would be glad to learn.

I saw little girls playing hop-scotch. I saw boys with sling shots. Others had marbles. Kids of the world are pretty much the same—it's when they get grown up that they change.

Vodka toasts, like campaign oratory, usually go in one ear and out the other. Before I flew from the Ukraine to the Caucasus, I heard one toast by a government official which stuck with me:

"You have seen the destruction we have suffered. You have seen us working with cradles, with sickles and with flails. We want you to come again when we have put away these things. Some of your people say we want war. When you go back won't you tell them—how can we possibly want war now when there is so much for us to do at home?"

(*News Gazette, Oct.*, 14, 1946.)

MONTHLY AGRICULTURAL REPORT FOR THE MONTH OF FEBRUARY, 1947

I—Season—During the first week of the month under review, there were light showers in a few districts and no rain in the other districts. During the second week, there were light showers in almost all the districts. During the third and fourth weeks there were light showers in many districts and no rain in the rest. The total rainfall for the month was in defect of the normal in all the districts.

II—Agricultural operations—Crushing of sugarance for *gur* and factory sugar was in progress. Preparation of seed bed for sugarcane and *zaid* crops continued.

Sowing of sugarcane and *zaid* crops was in progress. Irrigation of *rabi* and *zaid* crops continued in many areas. Harvesting of early *rabi* crops had commenced.

III—Standing crops and IV—Propsects of harvest—The standing crops are reported to be in a satisfactory condition except in some areas where the crops suffered from hail-storm and frost, but the effect is almost insignificant. The prospects of outturn, although favourable so far, are likely to be effected by the character of the season in the immediate future. The average anna condition of *rabi* crops for the province, according to the reports received from the District Officers, is estimated at 13·5 (16 annas denoting normal crop), or 84 per cent. of the normal.

V—Damage to crops—Damage to standing crops by hail-storm is reported from a number of districts.

VI—Agricultural stock—The condition of livestock was on the whole satisfactory, although cattle diseases have, as usual, been reported from a number of districts. The figures for the number of seizures, deaths and mortality from infectious cattle diseases during this and the preceding months are shown in Table 1, which has been prepared from the data furnished by the Director of Animal Husbandry, United Provinces. It would appear from this table that as compared with the preceding month, there is a pronounced decrease in the total number of seizures, a considerable fall in the number of deaths, resulting in a fall of mortality. As regards Anthrax, there were six cases of seizures and four of deaths during the month as against one case of seizure and death in the preceding month. In case of Haemorrhagic Septicaemia, there was a fall both in the number of seizures and deaths and also in mortality. No case of Blackquarter was reported from any district in this month while 45 seizures and 41 deaths were reported in the preceding month. As regards Rinderpest, there was a pronounced fall both in the number of seizures as well as deaths, but the mortality remained almost the same. In the case of foot and mouth disease there was a highly marked fall both in the number of seizures and deaths and a fall in mortality. As for other diseases there was a rise both in the number of seizures and deaths but a fall in the mortality.

TABLE 1

Number of seizures, deaths and mortality from infectious cattle diseases, in January and February, 1947

Diseases	Seizures		Deaths		Mortality	
	January	February	January	February	January	February
Anthrax	1	6	1	4	100	67
Haemorrhagic Septicaemia ..	92	74	91	61	99	82
Blackquarter	45	..	41	..	91	..
Rinderpest	972	508	475	256	49	50
Foot and mouth	2,747	908	32	1	1·2	0·11
Other diseases	26	99	20	65	77	66
Total ..	3,883	1,595	660	387	17	24

N.B.—Mortality = $\frac{\text{No. of deaths}}{\text{No. of seizures}} \times 100$

VII—Pasturage and fodder—Pasturage and folder are reported to be generally adequate except in some districts where there was scarcity.

VIII—Trade and prices—In Table 2 are given the average retail prices in rupee per maund of important agricultural commodities at the end of this and the preceding months. It would appear from this table that there is a slight rise in the prices of barley and gram, but that the prices of the remaining commodities remained more or less stationary.

TABLE 2

Average retail prices in rupees per maund of agricultural commodities for January and February, 1947

Commodities	Retail prices	
	January	February
Rice	20·055	20·045
Wheat	13·333	13·666
Barley	10·220	10·943
Gram	12·061	13·061
Arhar dal	17·172	17·545

IX—Health and labour in rural areas—The health of the rural population engaged in agriculture was generally satisfactory, but the prevalence of plague and small-pox is reported from some districts.

C. MAYA DAS,

Director of Agriculture.

Y. M. C. A., Rural Welfare Worker's Training Institute, Martandam, S. Travancore.

Under the auspices of the Y. M. C. A., Rural Work Department, a ten-months' theoretical and practical Diploma Course in all aspects of Rural Reconstruction will be provided at Martandam, South Travancore, for the benefit of English knowing men and women from July 1st 1947, till April 30th, 1948. Students, who may consider taking this Course, should apply to the Principal, Care of Y. M. C. A., Rural Demonstration Centre, Martandam, South Travancore, for a copy of the Prospectus.

Another student of the Home Economics Department of the Agricultural Institute, Allahabad, has been awarded a scholarship for study in the U. S. A. She is Miss Beulah Mall of Debra Dun, United Provinces. After taking her Intermediate Science in Home Economics at the Institute and teaching a year for experience, she has just completed her C. T. (Teaching training) course in one year. She will go to the U. S. A. to complete her course in Home Economics at the A. & M. College of Oklohoma.

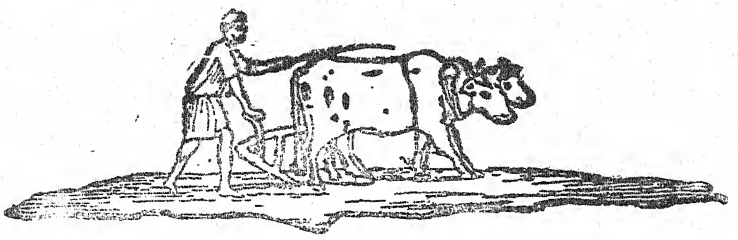
The last student to go under these auspices was Miss Pramila Pandit (now Mrs. S. R. Barooah) of Nagpur, C. P., who is receiving her M. Sc. in Home Economics this year from Oregon State College at Corvallis, Ore.

"It is the small work which is the most difficult of all; an imposing programme is often but an evasion of real work. Our sphere of activities lies near us and around us, in our homes and in our neighbourhood."—Tagore.

This is the ideal on which Tagore's work of rural reconstruction was based.

THE

ALLAHABAD FARMER



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Editorial

We are reprinting in this number of the Allahabad Farmer an article written by Dr. Harold H. Mann almost forty years ago. Out of the experience of his long career in Indian agriculture Dr. Mann wrote this article on The Introduction of Improvements into Indian Agriculture.

This article is worthy of very careful study today. While some details of it have been out-moded, his major contentions are as valid today as they were when the article was written. Moreover, they are contentions which many of our current efforts at the improvement of Indian agriculture overlook. He writes of fundamentals. Every time we consider a new programme of agricultural improvement, we should have these fundamentals before us. Since the visits of Sir John Russell and Mr. Norman Wright ten years ago, our attention has been increasingly directed at the problem of getting known agricultural improvements adopted in the villages. We are still feeling our way. This is the problem to which Dr. Mann addressed himself in his article.

Originally published in *The Agricultural Journal of India*, this article should be re-read often. To help the reader, we have inserted sub-heads and have italicized certain sentences which are of outstanding importance.

THE INTRODUCTION OF IMPROVEMENTS INTO INDIAN AGRICULTURE*

BY

HAROLD H. MANN, D. Sc.

The introduction of improvements into Indian Agriculture is surrounded by peculiar difficulties. The fact that, generally speaking, the agriculture of the country is in the hands of very small holders, who form a naturally non-progressive class, is the first of these. Perhaps of equal importance with this is the rigid separation, which has long existed and still exists, between the different classes of society throughout the larger part of the country, for as a result of this, the educational movements of the past few years have hardly touched the cultivator of the land. He, in fact, still remains largely out of contact not only with progress, but also with the knowledge of progress. And, if you add to these reasons the fact that the Indian farmers are usually men whose capital is little more than the ownership of their very small area of land, who work almost entirely on borrowed money, there results a condition of things which is eminently unfavourable to progress.

Comparison with another country.

This condition of things places India in the opposite extreme to those countries where the application of modern scientific discovery to agricultural practice has been most marked. Take, for instance, the United States of America. There your farmers are men of energy, of at least, a little capital, and are intensely alive to all that is passing in the great world : here, on the other hand, they are isolated, they are poor, they are usually content to go on in the way of their fathers. There, the existence of a large and well-organised agricultural department of agricultural societies, of rural banks is *the result of initiative among the farmers themselves* : here, that initiative is all but entirely absent. There, as a result, experiment and discovery are followed closely by a large and intimately-interested community : here, the result of any experiment or any discovery have to be forced on the attention of the people, and its adoption in practice has to face an amount of inertia, and a lack of available capital, that would seem inconceivable in most other countries.

Cultivators not overly-conservative.

expenses of cultivation, and the rate of interest which he has to pay often, if not usually, amounts to from 25 to 75 per cent. per annum. It is, therefore, not sufficient that an expert in agriculture can prove to himself that a new method will give a return of 10 or 20 per cent. over existing practice. Account must also be taken of the extra capital involved, and the rate of interest which will have to be paid for it. As the cultivators have no capital, they can take no risks. Unless they can be shown that the new method is a certainty, the cultivators will not, and rightly will not, take it up. A certainty will mean, as a rule, to a ryot, something which will give him a return of over 25 per cent. on any extra capital invested, and this fact must be continually in the minds of all those who propose innovations in Indian agriculture. This means; in other words, that until cheaper money can be made generally available, any improvement which can be brought into practice, if it involves any outlay, must be of a very marked character. It means, further, that the connection of effort for cheapening of credit by means of co-operation or otherwise, and that for agricultural improvement is very close,—closer perhaps than is generally realised.

Apart from these questions, the introduction of improvement into Indian agriculture is no easy matter. A considerable amount of experience has been gained in the last few years. Many failures have occurred: some successes have been obtained, and with a veiw to bring together the results of these experiences for future use, a committee was appointed at the meeting of the Board of Agriculture in 1908 to consider and discuss them, and express an opinion as to their applicability in the future. A second committee was appointed in 1909, and the result of its deliberations will be issued very shortly. It seemed, however, that there was room for a general statement of the method which had been found to be most effective in the present article.

Making Certain that the Improvement Fits Local Conditions.

To introduce anything which may be considered an improvement in the special conditions of Indian Agriculture, the first necessity is that you should be absolutely certain that your process or implement is actually an improvement under the conditions existing in any particular spot. This would, at first sight, seem a truism, and so it is. And yet, its neglect has led in the past to the greatest failures, to the loss of confidence by the *ryots*, and to sets-back to progress whose seriousness it is difficult to estimate. In the older days, for instance, American cotton was introduced into India in very large quantities. No experiments were made as to its suitability in many of the areas, where it was planted, either agriculturally or economically. What was the result? The cotton failed in many areas, of course. This would not have mattered so much, perhaps, in itself, but confidence was lost, the department introducing the cotton was thought by the cultivators to be unpractical, and they hesitated, to say the least, to adopt any other suggestion. The same story has been repeated elsewhere; new implements, new crops, new methods, excellent in themselves, have occasionally been introduced without adequate knowledge of local conditions, and without sufficient testing. The result has too often been failure, loss of confidence, and general distrust. It cannot be too strongly insisted on, that nothing can justify the recommendation of any supposed improvement, unless it has been preceded by careful experiment, and by the most careful local study.

But what does this careful local study mean? Does it simply mean that the method has been carried out successfully on an experimental farm in the same neighbourhood? So far as it goes, such experimental testing is excellent, but it is by no means all. Anyone who has dealt with this subject in practice must know that the difficulties which occur to an experimental farm manager are a very different thing from those which occur to a ryot. For instance, on an experimental farm a particular imported iron plough does excellent works, it is more economical in every way, and the crops are better. You take it out, and

are met at once by a villager who acknowledges its value, but at once asks how he is to get it repaired if he adopts it. No country *mistri* can deal with it, spare parts cannot be stocked either by the cultivator himself or in the village shop, and the plough, however good, has to wait until this difficulty is overcome. Or, again, you find a particular manure for sugar-cane. It gives excellent results in growth, and yield of *gur*. You recommend it, and are at once met by the statement that this manure always lowers the value of the *gur*. The lowering is relatively small, but there it is. It is probably that among the mass of samples on your experimental farm the difference has never been noticed, especially as it is a commercial difference not capable (so far as I know) of being detected by chemical analysis. But you must answer the difficulty or your manure will have to wait. And so on. Instances might be multiplied but the above must suffice to show the absolute necessity of local study as well as experiment before it is attempted to introduce an improvement. The whole resolves itself into being absolutely certain that your novelty is good and is applicable under the special local conditions.

Securing the confidence of the People.

This being ensured, the next step is to secure the confidence of the people. And here is perhaps the greatest difficulty of all. Indian ryots have, from time to time, been exploited by people of the most various kinds, sometimes with, sometimes without, intention, so that they are rightly suspicious. If anything is suggested, they at once look for the motive. What has the man to gain by it? Is he the agent of someone else? What has the Government he may represent to gain by it? Such are the questions which at once rise in his mind, and have to be met.

The winning of confidence has been accomplished in various ways; but whatever the method, it is of the first and most vital importance to the whole success of the work attempted to be done. In many parts of India the attempt has been made by the formation of local associations of agriculturists and those interested in agriculture among whom the improvements suggested can be discussed, by whom they can be tried, and, through whom, when successful, they can be extended among the surrounding people. Perhaps the greatest success in this direction has been achieved in the Central Provinces. There the members are nominated by the local authorities, they have as their chairman the District Officer, whenever they meet one of the senior officers of the agricultural department is present, and *membership involves readiness to try some novel method on the member's own land.* All proceedings are in the Vernacular, discussions are free, and enthusiam is often aroused, and these associations have succeeded in bringing the agricultural department into touch with the cultivators, and in giving them confidence in one another. As a result, numerous improvements have been made. Improved varieties of jowar, sugarcane and other crops have been introduced, the fighting of *smut* in *jowar* by pickling the seed has been largely adopted, in some of the backward tracts great improvement in rice cultivation has taken place, and new, improved implements are now in some districts regularly used.

I have quoted the Central Provinces because the idea of agricultural associations has been more developed there than elsewhere, but they have been formed in other provinces, sometimes as more independent, sometimes as more official bodies, with varying success. The movement is in its infancy, but enough has been seen to indicate the general lines in which they are likely to be most valuable. In the opinion of the Committee (whose work I am summarising), it may be said that their utility seems largely to depend on the presence of a body of men directly interested in cultivation, on the personal touch of the higher staff of the agricultural department with the members, on the

definite engagement by the members to do definite pieces of work, and on the regularity of meetings, inspections, and reports.....No association, large or small, should be formed until there is something of the nature of a spontaneous demand on the part of the people themselves or until the agricultural department is in a position to advise and guide them in their work. Where the agricultural department has failed to create such interest the association is bound to fail in its object."

Demonstration Plots.

The next method which has been used, is that of demonstration of the value of improvements on the spot, usually by instituting a demonstration farm for the purpose, or by temporarily hiring some land from an actual cultivator. In either case, if it is to do any good, the confidence of the people must be won either before or during the demonstration itself. Nothing is more common than to find that the cultivators have a haughty disdain of what is done on a Government farm, it is considered that, however good the results may be, they can only be done under conditions of money and *personnel* that only Government can secure. Hence, except in exceptional cases, *it is probably not wise to institute a special permanent farm for demonstration purposes*; by far the better way, so experience shows, is to engage a temporary plot or utilise a private farm. *It is essential that everything be done as a cultivator can do it*, and that the man in charge should be a cultivator himself, or at any rate, with whom they can get into perfect intimacy. Supervision there must be, but *it is essential that the man actually in charge should be of the same type as the people he is working among*. He has then two things to do, to gai their respect and confidence, and to show that his method is better than that which is adopted round about him. He must understand, too, that *the success of the demonstration will be judged by the extent to which it is adopted*, and that this is the only test.

Working on these lines it has been possible to make considerable progress in Madras, in the Central Provinces, and in several other parts of India,—new varieties of crops have been introduced, new methods have been largely adopted, and it seems likely that this will form one of the most effective means of introducing new matters into the practice of cultivators.

These methods are not limited to matters of cultivation. New machinery can be equally well shown by men of a similar type. A gang of men has, for instance, been employed for years in Bombay, demonstrating from place to place, the best methods of boiling *gur* (crude sugar) : the use of reaping machines has been brought to the notice and into the practice of agriculturists in the Punjab similarly, and many other cases might be cited. The essential point in it all, is that *everything should be shown under cultivator's conditions, by men who are themselves intimately in touch with the people and their problems.*

Other methods have been utilised for gaining the confidence of the people the essential preliminary to doing very much for the introduction of improvements. In the United Provinces and in the Central Provinces, advantage has been taken of the period of stress following severe famine to help the cultivators with large quantities of good seed, and the like, and the confidence thus gained has been very great. Again, travelling agents have been employed in going from place to place, generally on some special quest, and getting into touch with villagers and cultivators in Bombay. In this case the men employed should be of considerable experience, be thoroughly imbued with the fact that they are the servants of the people, and be, if possible, cultivators themselves. And so on. But confidence must be gained, I would again insist on the matter, before anything material can be done.

Methods of Reaching the cultivator with new Improvements.

When the confidence of the actual cultivators has been secured, the greater part of the difficulty is over. It is then only a matter of showing, of clearly proving, that what you recommend is good and will pay, and the chief trouble is to ensure that your information actually reaches the cultivators themselves.

The number of methods which can be adopted for this purpose is very great. The most certain in effect have been already referred to, *the formation of local associations* of agriculturists where matters can be freely discussed, and in connection with which members will make trials for themselves and for their neighbours to see, and *the institution of demonstrations* by the agricultural department either on cultivators' land specially hired for the purpose, or by special demonstration farms. Where applicable, both these methods are effective, in almost all cases. The spreading of demonstrations over larger areas under the control of the agricultural department, however, involves a very large staff, and a very well trained staff. This is not likely to be available for many years to come, if ever, but so far as it is available, whenever there is anything definite to be shown, the methods of local demonstration has proved itself extremely effective. As already stated, the Committee feel that experience has shown that plots taken from cultivators for a short period, and placed under a man who is himself a cultivator well trained for the particular demonstration farms. Such plots should be small, should limit themselves to special and definite demonstrations, should show nothing which is not certain to be a success, and should be accessible to surrounding cultivators at all times.

But beyond the relatively small area which even a very large extension of such demonstration areas would cover, we must rely on agricultural associations to meet the need to a large extent. As already described, they enable us to carry the ocular demonstration of our improvements to a very much larger area, but their number is circumscribed by that which can be covered by the senior staff of the agricultural department, who must act as inspiring and suggesting influences to everyone. *However, enthusiastic local men may be, they expect and require constant touch with the experts of the agricultural department*, and the extension of associations is limited by the possibility of giving that touch. It is no use sending inferior men to them, those employed to guide and assist associations must be of considerable experience, usually well skilled in the vernacular, capable of inspiring work, and with a stock of suggestions for improvement which are proved successes, and which will meet the cultivators' needs.

Learning the Cultivators' Real Difficulties and Needs.

The last point perhaps merits a short digression. It is impossible to insist too strongly on the necessity for finding out what are the cultivators' difficulties and needs, before any attempt to introduce improvements is made. It is a slow business to attempt to bring into use anything for which a need has not arisen. It is useless to talk of artificial manures to a man whose crops are failing for want of water, and yet this has often been done in the past. It should always be remembered that the finding out of the cultivators' wishes and needs is the first necessity, and the devising of means to meet them the second, and their presentment to him in one way or another then follows and is welcomed.

Exhibitions, Shows, Publications.

To enable improvements to be carried out over a wider area, we must return to those methods which have been successes in other lands,—such as exhibitions, shows, publications and so on. They will be successes if you already have the confidence of the people, otherwise they may cause much talk, but will lead to little real effect. Hence the value, so far as ultimate results are concerned, of these methods has been very various. But if the essential condition is obtained, then a great deal depends on the manner in which these methods are adopted. A large amount of energy has been spent in recent years in organising large

exhibitions in several Indian Provinces in which a vast amount of work has been put into the agricultural section. These have been held in Bombay, at Calcutta, and the culmination was reached in that recently held at Nagpur. In each of these cases, and particularly at Bombay and Nagpur, very great efforts were made to secure the attendance of large numbers of actual cultivators, and to show them everything which was to be seen. These exhibitions have certainly been effective in inspiring very great interest, have made the agricultural departments more widely known, have spread the knowledge of advanced methods into corners where this had never before penetrated, and have directly led, in the hands of the more substantial cultivators, to the introduction of seed and implements.

Such large exhibitions can only, however, be organised on special occasions and under special circumstances. Local smaller shows can be held at more frequent intervals, and range in size from institutions like the Lyallpur fair in the Punjab, annually attended by one hundred thousand people, to small *taluka* shows in parts of the Bombay Presidency, or to the demonstrations which are made in connection with smaller cattle fairs and festival in Madras. On the whole, the Committee have felt that if such shows are to lead to real effective improvement, their organisation should be very carefully done. While local effort may and should arrange the show, the part which the agricultural department takes in it should be very carefully organised and attended to by one of the superior staff of the agricultural department. *Agricultural products which are not and cannot be produced on the cultivators' own lands should be excluded.* As many things as possible should be shown in action; as these are always centres of attraction. Popular lectures should be combined with practical demonstrations. Farm produce should be arranged in sufficiently large quantities to allow of being handled by those interested in them. If these conditions can be attained, it is probably that a larger number of smaller shows are more useful than fewer shows on a larger scale.

It may be well to consider the whole question of agricultural publications together, so far as it is made for the purpose of introducing improvements into practice. In some parts of India vernacular agricultural journals are issued, in some information which it is desired to spread is sent out in leaflets, in others again the general press is considered sufficient, and in Madras, an agricultural almanac in the various vernaculars is published. It is natural that in a matter like this the methods should differ, in each part of India, as the habits of the people vary. But whatever is done must be done well, and *must be written simply and in such language as the cultivators know.* This latter point is of importance, for there is a danger that if a translation into the vernacular be made by a non-agriculturist, it will abound in phrases and words totally unintelligible to the ordinary cultivators. Again, *any article, any leaflet, should be short,* perhaps not exceeding a couple of pages, and should contain *one definite fact or the description of a single process* which it is desirable that the *ryot* should know and adopt, with illustration whenever possible. The circulation of such material is a difficult point. A vernacular journal, which has to be paid for, is excellent if it only has a large enough circulation among actual cultivators. Such a circulation is not very easy to work up,—and the agicultural department in the Central Provinces is the only one in India by which this has been really accomplished. Leaflets, being distributed free, can be spread more widely, but much of the distribution is useless. To avoid this they are, in Bombay, generally used (1) in connection with demonstrations of implements and methods, as for instance, at shows; (2) in a limited area where special need has arisen. They are rarely distributed without, at the same time, arranging for the presence of an officer who can explain the nature of the improvement. Even with all these precautions, *the extent to which such leaflets are really useful is still problematical.*

Of course, it is possible to use the general vernacular press for publication of agricultural information. This is now very widely read in by far the greatest amount, however, among the non-agricultural classes. Articles and materials are, however, freely taken, and with a properly organised system of contribution, a considerable result might be expected to flow from its utilisation. If material is sent to the press for this purpose, no efforts should be spared to give the contributions a popular readable form, such as likely to command attention.

Schools for Sons of Cultivators

We have now considered most of the methods which have been adopted to ensure a wide extension of the knowledge of agricultural improvements. But there is one other to which I would like briefly to refer, namely, the training of the sons of cultivators in practical agriculture either on the farms of the agricultural department, or in special institutions. This has been carried on to a certain extent at Nagpur, and also in Bombay. The whole matter is, however, as yet in an experimental age. Difficulty has been found in attracting, the right class of student and those who come do not, by any means, always wish to go back to improve their own land. Where the right type of boys have been attracted, and where the course has been short and practical throughout, there have, however, been a good number of cases of success. But the whole question of the large applicability of such training is at present doubtful, and a very considerable amount of experiment will be required, and that under different conditions, before the best method is ascertained.

Minor Methods

I might refer to many other methods which are of narrower application, but have been of service on particular cases. In certain cases lands have been colonised with good cultivators with very great effect on the character of the agriculture round about them ; in others, individual cultivators have been sent to new areas to teach the people round about them, their own methods, and so on. But, again, it must be recognised that there is no general method; the conditions differ so much from place to place, and from province to province, that it is absolutely impossible to lay down anything more than indications of such methods as have, in particular places, given successful results in the past.

Summary

In conclusion, there is sufficient information in hand now to indicate that, in spite of its peculiar difficulties, agricultural improvement is now possible in any part of India. There is, however, no royal road,—the progress is, and must be for a long time to come, very slow. But, whatever methods be adopted, the actual process must be the same. To find the cultivators' real difficulties, to discover a practical and certain method of meeting those difficulties, to gain the confidence of the people: these all must precede any definite attempt at propaganda. If the attempt is made to introduce so-called improvements without these necessary preliminaries, then not only will failure result, but what confidence there may be will be undermined, and progress in the future will be made harder. Recognise the necessary order of events, try to satisfy the cultivators' needs and not something you imgine he ought to need, let your experiment be based on the requirements of the ryot, and success, though slow, will, if past experience be any guide, be sure.

A NEW TRACTION DYNAMOMETER FOR THE MEASUREMENT OF DRAFT POWER OF CATTLE.

By

Mason Vaugh.

There has been for a long time, a need for a simple type of dynamometer for measuring the draft ability of work animals. Traction dynamometers for any purpose have been expensive and complicated to operate. In America and in Europe, large units designed for testing teams or pairs of animals have been built, using generally a truck chassis with a power takeoff on the transmission to drive an oil pump. The rotation of the rear wheels drove the transmission shaft when the truck was pulled by animals. An oil pump was connected to the transmission which circulated oil trough a valve in the discharge line. Partly closing this valve throttled the flow of oil and so absorbed the power in forcing the oil through the restricted passage of the valve. The animals were hitched by a rope which passed over a series of pulleys and was attached to a system of dead weights, to which more or less weight could be added. The pull of the animals lifted the weights which were connected through a linkage to the throttling valve in the pump discharge line. Lifting the weights closed the valve, allowing them to lower opened it. In this way the resistence to movement of the vehicle was adjusted to that valve necessary to keep the weights suspended so the pull of the animals was equal to the weight fixed.

Some years ago, the Agricultural Institute tried to build such a dynamometer on an old tractor chassis and adapted to bullocks. It was not very successful and parts were stolen in transit when it was shipped to the All-India Cattle show. Recently, M. A. Sharp has described such a dynamometer in the December 1946 issue of the journal of the American Society of Agricultural Engineers adopted for testing single animals.

Experience with other types of dynamometer equipment in connection with the scheme for measuring draft ability of bullocks at the Agricultural Institute, indicated that there was still a need for a better type of dynamometer which could be used either for sustained loading or for maximum draft tests. Accordingly, in the 1945-46 programme, such a dynamometer was designed and built, using the same old Austin tractor chassis formerly used This has been quite successful and it is thought that it may be of interest to others, so is described below.

Construction of Dynamometer.

The tractor chassis had the rear axle gearing, including the whole transmission and belt pulley drive intact and in good condition. Large size truck tires, 10·50×16 in this case, were fitted to the rear wheels. Other size tires could be used, the only requirement being that there be adequate traction adhesion to the ground. In front, the axle was removed and a small caster wheel and rubber tire supplied by the Dunlop Rubber Co., was fitted. The caster wheel made smaller turning radius and easier manipulation possible than would have been possible with the regular front axle and steering arrangement, even if it had been modified.

On the belt pulley shaft, a brake drum and band brake from an old car were fitted so the drum rotated when the vehicle moved. The brake band arrangement was connected through a suitable linkage with a weight system so that when the weights were lifted by the pull of the animal, the brake band was tightened; when the weights were lowered the brake was released. By slight adjustment of the brake band and of the linkage, it was possible to get adequate braking when the load lifted only a few inches and complete release when the weights were at the bottom of their travel. The load could be easily adjusted by adding or removing weights.

The tractor chassis was used because it was available. Instead, a satisfactory dynamometer of the same principle could be built using a rear axle of a truck. It would be desirable to modify the frame to get a shorter wheel base and to mount a caster wheel in front. In such a case, either of two arrangements for the brake might be used. If the original brakes are intact and in good condition, the weight system could be connected directly to them through the existing equaliser system. This would be quite easy in the case of mechanically operated brakes. It would be somewhat more complicated in the case of hydraulic brakes, but could doubtless be done. Alternatively, a suitable brake drum could be fixed to the drive shaft just in front of the differential and the brake shoe assembly would be fixed to the axle housing. The linkage to the weights system would then have to be built new to operate the brake shoes. Either internal expanding or external contracting type brakes could be used, with suitable modification of the linkage for operation. Using the existing system would be simplest to build ; fixing the drum on the drive shaft would obviate any difficulty with unequal adjustment of the brakes, etc., and would be most satisfactory in use.

In the original old tractor chassis used, the speed change gear was still present and the drive from the wheels to the belt pulley shaft was through the gearing. Putting the gear shift into neutral provides an easy way to disconnect the dynamometer rig when it was desired to only move the dynamometer from one place to another. Where this facility is not available, it would be easy to have a fixed towing hook to which the hitch could be attached.

General Comment.

The dynamometer proved to be quite sensitive, responding to as little as 5 lbs. increment in weight. Maximum pull tests are made by successively adding weights and having the animal pull the dynamometer a minimum fixed distance, until a weight is found which the animal cannot or will not pull. In the tests so far made, final tests have been taken with increments of 10 lbs.

While actual tests by this method have not so far been carried out, the same dynamometer can be used for continuous steady loading by putting the weights corresponding to the desired load and driving the animal over any desired route for the desired time. The nature of the track is unimportant to the test, in so far as the dynamometer is concerned. The animal only has to pull enough to lift the weight. Where ground conditions provide high resistance to the pull of the animal, less resistance is required to be provided by the braking system. While tests have not been made as yet on this, it is expected that this will be an important feature in future testing of the effect of the kind of surface on the fatigue of the animal.

Where it may be desirable to use smaller tires or where large ones are not available, filling of the tires with water will provide extra traction. They may be filled either partially or completely as the need may be. This is more convenient than adding weight otherwise to the machine. It is desirable to have as much of the weight as possible on the rear or traction wheels.

No estimate is available of the probable cost of such a dynamometer. Ours was built of old material for the most part, and other equipment was donated or loaned. It should be possible for any moderately well equipped machine shop to build such a dynamometer. An electric welder would be of great help but not absolutely essential. No drawings are available as the dimensions will vary according to the equipment used. None of the dimensions are critical and they can be changed without affecting the accuracy. It is only necessary that the weights be fairly accurate. We find a set consisting of the following sizes to be reasonably sufficient for testing single animals.

FURTHER OBSERVATIONS ON WEATHER AND PLANT DISEASE AT ALLAHABAD.

By

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It has been recognized for a long time that the weather plays a very important part in the epiphytotics of plant disease. The changes in temperature, humidity and rainfall from season to season have been held responsible for the corresponding changes in the activity of plant pathogens. During recent years a number of plant pathologists have written of the weather and its influence upon plant disease. Although the term *weather* is rather vague, under that term are included a number of factors which are more or less readily understood by the average person. Until the factors constituting weather were analyzed one by one and the changes correlated with the changes in plant disease, very little real progress was made in the understanding of the relationship between them. One of the first of such studies was that made by Dr. L. R. Jones (7) and his associates at the University of Wisconsin in which, by means of control chambers, it was possible to study the influence of the soil factors upon the root rots of cabbage, tobacco and potato.

During the early days of plant disease study, there was much confusion in the use of terminology by the plant pathologists. Perhaps we have not yet reached the stage when we can say that we talk a common phytopathological language but we are making progress. Article on the clarification of terms by such authors as Link (8) have done much to help us to a common agreement on the use of terms.

The attention of the plant pathologists has been focussed on the problem of weather and plant disease by a number of articles appearing during the past half dozen years. Foister (3) in 1935, and again in 1947(4) has written summaries of the relations of weather and fungous diseases. Garrett (5) has written of the effects of climatic factors upon the root diseases of plants with special attention to that of the cotton root rot organism in Texas, U. S. A.

More recently Stakman and Christensen (13) have written an excellent article on the relation of airborne spores of fungi and disease. Their article is of special interest to the plant pathologists of India who are well acquainted with the work and articles of Mehta (9, 10, 11).

There are still many factors bearing on the spread of plant pathogens which are not thoroughly understood. When an extremely heavy epiphytotic occurs or there is an absence of a particular fungus, guesses are hazarded as to the cause but it is not possible, with the knowledge possessed by man at this time, to be certain that all of the contributing factors have been taken into account or that they are understood in their relation to the cause of plant disease.

Weather is largely local and rarely is the same over a very large area at one time. A distance of only a few miles may have a profound effect upon the conditions affecting the growth of the host and parasite.

At Allahabad, rainfall, humidity and temperature data have been collected for a number of years, but it is only recently, however, that there has been any attempt to correlate these data with the observations on the fungi and plant disease present on the crop plants. During the past two years a number of observations have been made of fungi which appeared on the various crop plants on the Institute and neighbouring farms. An attempt has been made to associate these observations together so that some of the inter relationships might be understood. Notes on the observations during 1945-46 have already appeared (18, 19) and will be repeated only for the purpose of comparison.

Temperature, rainfall and humidity data collected at the Allahabad Agricultural Institute for the years 1940 to 1947 are presented in Tables No. I, II and III. Monthly averages from June to March, inclusive; only, are shown as the hot season finds most of the fungi dormant and April and May, being during the vacation period, observations are not made regularly.

TABLE I.

Temperature.

Year	Month									
	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	March
1940-41	93·72	83·38	83·19	83·45	80 30	69·48	63 ·00	60·78	64·64	75·95
1941-42	89·60	86·40	83·70	83·20	80·10	67·63	62 22	59·26	64·80	75 60
1942-43	94·34	83·75	82·28	81 72	78·50	68·23	60·85	66·07	63·14	75·92
1943-44	92 88	85·63	80·80	83 50	76·84	67·89	61·28	60·54	62·54	73·70
1944-45	82·65	86·95	81·33	79·45	74·62	68·38	62·60	59·56	68·19	
1945-46	84 30	85·90	86·32	82·75	75·92	65·66	59 70	61·91	64·34	72·45
1946 47	87·93	86·83	83·30	83·00	75 90	68·000	63·24	58·01	63·09	76·19
Average:	89·33	85 55	82·89	82 44	77·45	67·89	61·85	60·94	64.5	74 80

It will be noticed that during 1946-47, some rain fell each month of the period June to March, inclusive. It was the only June to March season since 1940 that this occurred. The total rainfall for that period was just under the seven-year (1940-1947) average, but it was much more evenly distributed than in any previous season. This uniform distribution of the rainfall was probably the chief factor which produced the consistently high humidity for the period. Comparing the per cent. of humidity for the 1946-47 period with that of the corresponding months of the other seasons, it becomes evident at once that there is a greater difference between the 1946-47 season and the others than between any two other seasons. Also that the 1946-47 season's humidity was consistently higher from June to February, inclusive, than the seven-year average. Just how much influence the weather at Allahabad exerted on the plant disease fungi is not clear at this time, but, as will be shown later, some factor or factors did produce differences in the plant disease and it would appear logical to attribute some, at least, to the humidity.

During the kharif season of 1945-46, *Choanephora* spp. (18) were especially active and in a number of cases were apparently actually pathogenic. In the 1946-47 seasons *Choanephora* was found only on the blossoms of brinjal and some of the *Cucurbits*. It appeared to be only saprophytic on the petals. Leaf spotting fungi, such as *Cercospora*, *Alternaria* and *Phyllosticta* spp. were no more active than during the 1945-46 season. However, the lack of a really accurate measuring stick makes any such statement lose much of its value. We do not know just how to measure the affects of the pathogens and the weather so that each may receive its share of the blame for disease.

There appeared to be little difference in the activity of the root rotting fungi. There was perhaps less wheat seedling disease but more activity among the pathogens that attacked the brinjal plants. *Pythium* sp., together with *Rhizoctonia* and *Fusarium* spp. have been isolated from each of the crop plants mentioned.

TABLE II.

Rainfall.

Year	Month										Total rainfall
	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	March	
1940-41	0 80	4 87	14·72	5 60	0·12	0·02	0·00	1·03	0·20	0·00	26 86
1941-42	2·74	5·72	5·28	8·65	0 04	0·00	0 00	3 96	4·30	0·36	31 05
1942-43	4·52	7·10	9·98	8 22	0·00	0·00	0·16	0·57	0·22	0 00	30·77
1943-44	0 80	8·29	19·78	8 78	0·74	0·00	0·00	0·00	4·58	4·38	47·45
1944-45	1·09	8·64	19·04	4·98	2·09	0·00	0 90	2·00	0·00	..	38·74
1945-46	1·21	5·62	11·65	1·29	2 97	0 00	0 00	0 00	1·00	0 00	25·36
1946-47	3·69	10·60	12·61	2 91	0·75	1·13	0·08	0·29	0·34	0·45	31·02
Average :	2·12	7·19	13 01	5·77	0·96	0·16	0·16	1·12	1·52	0·86	32·89

But with the observations made to date it is not possible to much more than hazard a guess on the possible influence on the pathogens of the weather of 1946-47. Potato diseases this season were approximately the same as for the 1945-46 season. but there is a slight difference in the per cent. of the various diseases. In 1945-46 the bacterial soft rot and the *Rhizoctonia bataticola* soft rot were the two most serious. In the 1946-47 season the bacterial soft rot was little more than a trace whereas the *R. bataticola* was about the same as last year, namely, from 3 to 5 per cent. In 1946-47 *Sclerotium rolfsii* was present to perhaps 1 per cent. and *Fusarium* spp. to slightly more. *S. rolfsii* was not observed in 1945-46. The entire loss due to all forms of disease at the digging time was about 5 per cent. The loss in 1945-46 was 8·32 per cent (19). A light rainfall and a higher humidity during the months of December, January and February did not appear to seriously increase the amount of disease in the potato fields.

Root rotting fungi in the young papaya orchard were active and the loss by the end of the season approached some 20 per cent. of the trees. This loss is not considered to be especially influenced by the weather conditions, but more by the continued building up of the soil flora of *Pythium aphanidermatum*, *Rhizoctonia solani* and a *Fusarium* sp. that have been almost constantly associated with the papaya root rot in this area.

The outstanding differences between the fungous diseases attacking the local crops has been found among the rust fungi. In 1945-46 the first wheat rusts appeared February 9, when all three of the common rusts were found on local wheat growing on a Mahewa village farm and on the same day on wheat growing in a sullage water overflow along the channel used for irrigation of the Institute farm. It had been anticipated that the leaf rust would appear first and, during normal seasons, it may be expected any time after the first of December. But the humidity for the months of December and January, 1945 was some 13·00 per cent. below the six-year average while the temperature was approximately average. There seems little doubt that this was one of the main factors in the delayed appearance of the rust.

TABLE No. III.

Humidity.

Year.	Month									
	June	July	Aug.	Sept.	Oct.	Nov	Dec.	Jan.	Feb.	March.
1940-41	48·30	78·00	82·70	73 50	58·00	52·20	71·80	78·96	66 58	41 55
1941-42	63·56	70·36	83 62	83·20	80·60	53 42	80·96	80 22	77·65	59 76
1942-43	49 08	86·24	79 25	79·52	76·08	74·00	81·03	61 77	75·70	51 59
1943-44	56·80	72·60	93·24	88·00	86·95	73 89	78·84	81·62	81 66	78 80
1944-45	54·70	89·60	88·55	78·76	78·86	69·83	53·80	58·60	..	..
1945-46	53·00	60 65	67·47	76·12	75·50	67·44	60·70	58·30	64·89	52 68
1946-47	56·23	83 50	90 80	86 86	80·30	77·86	81 56	81·02	78 25	56 44
Average:	54·52	77 28	83 66	82·15	76 61	66 93	73 95	71·49	74 12	66·50

Following the 1946-47 weather records it was possible to predict the approximate date of the appearance of the leaf rust. Actually the leaf rust appeared a few days before it was predicted. The first record of leaf rust at Allahabad was December 9. Stem rust did not appear until approximately one month later. The first record was January 14, but it was thought that the infection was about one week old when found. Stripe rust did not appear at all at Allahabad. This is the first time in a number of seasons that there has been no stripe rust on the local wheat or barley. The information at hand does not at this time account for the lack of stripe rust. It would be expected that ripe rust would behave very much as the leaf and stem rusts. Wheat and barley have been planted on the same fields each season and as they were both susceptible to stripe rust it cannot be said that rotation of crops played any part in stripe rust absence.

Pea rust and alfalfa rust were both prominent during the 1946-47 season. Pea rust was serious during the months of February and alfalfa rust reached its peak of severity in the month of March. Pea rust has been present on the farm from year to year, but usually is present only as a trace. It usually requires some effort to secure sufficient specimens for class needs. Alfalfa rust has not appeared before but this season it has actually killed much of the lower foliage on the older plants Powdery mildew has been unusually servere on peas and *Cucurbits*. This is no doubt a direct response to the increased humidity.

Sann hemp rust was observed for the first time in several seasons and caused a little damage to the leaves. Linseed rust was not as servere as usual. Gram rust, present as a trace in 1945-46, was not recorded in 1946-47. Earlier in the season bajra rust was observed rather generally over the area, but did not cause more than a trace of loss. During the kharif season of 1945-46 a *Helminthosporium* disease appeared on maize and caused a small amount of damage. In 1946-47 a *Helminthosporium* disease (which was considered to be *Helminthosporium turcicum*) caused serious damage to the leaves of maize growing in the fields of the Institute. This may be a case of varietal susceptibility (the variety in this case being a Jaunpur variety) but it is intended to continue observations on the weather and the activity of the fungus during the future seasons to catch any relations that may be observed.

Under the control of the extension services of the various countries, there have been organized during recent years what are being called plant disease forecasting services. Examples of such services are the late blight of potato forecasting, reported by Melhus (12) and the leaf rust epiphytotics of wheat by Chester and Larsh (2). Such services require a number of cooperators who will make regular, accurate observations and relay the information immediately to some centre where it may be sorted out, consolidated. Then from the whole picture, the likely trend in the plant development may be predicted and this in-

formation quickly sent to the areas that are most affected. There, possible control measures may be put into effect in time to be of value. Melhus (12) in his work on late blight forecasting, secured data from eleven Upper Mississippi Valley states and from the Provinces of Alberta and Saskatchewan in Canada. Reports were often secured by wire in order that the entire picture might be had in time to send the information back to the affected areas for action. Such a service takes time to develop and it requires the effective cooperation of a number of workers but it is amply worth while and is not too difficult for India.

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"For a number of years past critical examination of the effects of cultivation operations on the soil, soil moisture, plant growth and yield have formed an important section of the Department's work. The earlier results ran counter to certain of the traditions that have grown up around the subject, and possibly for that reason, were viewed with scepticism. Later work, however, has confirmed the views set out in the previous investigations: Crop yields are relatively insensitive to cultivation treatments; cultivations do not have the effects in soil-moisture control formerly attributed to them; weed control is most important in the early stages of crop growth. Since 1939 six papers have been published, summarising various aspects of the results.....The sixth paper examines a large number of United States experiments on crop response to Inter-row tillage, extending over many soils and seasons, and shows that they agree with our own results, in spite of the large differences in weather and soil and the use of different crops.

"A three-year experiment in Surrey on a loam soil overlaying sand and gravel, on the effect of Inter-row tillage on potato yeilds was completed..... These experiments fell into line with the general conclusions already mentioned above: yieldswere insensitive to cultivation treatments, but were appreciably reduced by even moderate weed competition in the early stages of crop growth.

"The six-year cultivation experiment, begun in 1934, was completed..... They show no yield difference between deep and shallow working, with the possible exception that maintenance of mangold yields may require an occasional deep cultivation. The ploughing treatment was better than the other two, for the probable reason that it showed the most efficient weed control."

The above quotation from pages 35-36 of the "Report for the War Years 1939-1945" of the Rothamstead Experiment Station, Department of Physics, by Dr. B. A. Keen, seems to call for careful consideration by Indian agricultural Scientists. Why do we cultivate, plow or otherwise work the soil? Is it possible that if we knew more accurately why we do certain things, if it were more a matter of knowledge than of "tradition," we might find it desirable to do an entirely different set of operations?

As a sample of what is meant, is dry weather—or so-called "hot weather" plowing primarily a soil benefitting operation or is it primarily of value as a farm management practice, helping to smooth the peak of labour demand in the early rain? It would appear that there is a fertile field for investigation here, as yet little touched.

—*Mason Vaugh*

POST-WAR DEVELOPMENT OF AGRICULTURE IN UNITED PROVINCES*

By

C. Maya Das, Director of Agriculture, U. P.

It has to be admitted on all hands that the yields per acre of our food crops are among the lowest in the world, our density of population ranks very high compared to other countries and is growing ; the economic status of our *kisans* is extremely low and the ratio of agiculture to industries is extremely wide. The problem of post-war agricultural development, therefore, may be stated in a nutshell as one of increasing agricultural production to such an extent as not only to relieve materially the food situation but to improve substantially the economic condition of our agriculturists.

FIVE-YEAR PLAN

That both the Central and Provincial Governments are alive to this problem is borne out by the fact that five-year plan of post-war agricultural development is at the moment in hand. A brief examination of this plan reveals that the water and fertilizer requirements of food crops are receiving the greatest amount of attention. No less than 50,000 masonry wells are to be constructed for holdings of not less than 5 acres. The cost to Government of this one scheme alone, during the year 1947-48, will be Rs. 30,00,000 of which half will be met by the Government of India. As a corollary to this, 25,000 wells will be boed for higher yields of water on a subsidy basis and 6,000 Persian wheels per annum will be installed on masonry wells also on a subsidised basis in order to get the best results. For the larger farmers 1,000 tube-wells will be constructed on a 50 per cent. subsidy basis.

FERTILIZERS

Next in importance to irrigation is manure and by the end of the fifth year no less than 10,00,000 maunds of oil cake fertilizer will be distributed annually. Similarly, the valuable chemical fertilizer ammonium sulphate which is so much in demand, will be distributed to the tune of 2,15,000 tons in five years and bone-meal to the extent of 26,000 tons at a price of Rs. 60 per ton as against the present price of Rs. 115. Green manuring, so important an item in increasing production as well as in ameliorating soil condition, is to be encouraged. The target for distribution of *sanai* seed for this purpose is 50,000 maunds per aunum on a 50 per cent. subsidy basis. Similarly, the making of compost both by individual *kisans* and by co-operative methods, as well as the preservation of urine earth and tank earth, is being subsidised subject to a maximum of Rs. 50 being paid to any individual cultivator.

A scheme for composting town refuse into valuable manure, which has been running successfully during the past two or three years, is being intensified and the ultimate target is 260 centres in the province manufacturing 6,00,000 tons of manure each year.

TRACTORS

Power cultivation by tractors has so far been restricted by the non-availtability of tractors and necessary implements. It is expected, however, thad during the current year a considerable number of tractors will be imported an both the eradication of *kans* and the cultivation of large fallow areas will receive

*Reproduced from 'National Herald,' May 11, 1947.

the attention of the Agriculture Department. Mechanical cultivation will also be a part of the plan of colonisation in the Terai and Ganges Khadar areas. Rs. 47,00,000 have been provided in the current year for this scheme which envisages resettlement of ex-soldiers on co-operative farms.

This is an interesting plan inasmuch as a large part of the area, which it is proposed to colonise, is extremely malarious and steps have already been taken to start an anti-malarial campaign such as has been successful during the war on the Eastern Front, and more recently in the Moplah country in South India. The development of Kumaon and the Kheri districts is receiving special attention in the five year plan. A Development Board has been appointed for Kumaon and a provision of Rs.1,40,000 has been made in the first instance to start this work.

GOOD SEED

Apart from irrigation, fertilizers and improved cultivation, one of the most important factors in increased production is the supply of good pure seed of high yielding varieties. There are several schemes in force to meet the demand for good seed, chiefly of our cereal crops. Through a net-work of some 780 seed stores, the aim is to secure the best seed first from Government farms, from there to registered growers and from there to the distributing centre. Similarly, a scheme for the development of horticulture in the province envisages the production and supply of a very large number of plants from a number of registered nurseries scattered over the province.

PLANT PROTECTION

The Fruit Development Board has recently been reorganised and the entire horticultural development plan has been entrusted to it with the help of the Department of Agriculture. A Plant Protection Service is to be established as part of the five year plan. The object is to organise and control operations against the major insect pests and diseases of crops in the province at a total cost of nearly Rs. 1,50,000. Apart from these and other schemes of development, a committee has been appointed to reorganise the entire Department of Agriculture, both on the development side as well as for research and agricultural education. A part of the new plan of development has already been put into operation by the appointment of a Development Commissioner, whose main function is to co-ordinate effectively the efforts of all development departments in specified areas of concentrated activity in each district of the province.

INCREASED PRODUCTION

In so far as the overall target of increased production of food crops in the U. P. is concerned, the present Five-Year Plan of development is expected to result in about half a million tons of more food being produced annually in the province at the end of this period. Similarly, the overall target of increased production for the whole of India to be achieved in the same period is about 4 million tons. Even this target falls short of India's food requirement by some two million tons. Obviously, therefore, while the Central and provincial governments as well as Indian states have taken in hand a fairly big programme of increased production, we will have to devise some more revolutionary scheme if our production is to increase sufficiently to provide a higher standard of living for our rural population and at the same time meet all our obligations in the matter of food supplies.

AGRICULTURAL POLICY

Revolutionary ideas are generally looked upon with suspicion by our economists, but it is only by following such ideas that the United Kingdom was able to step up agricultural production during the war by 70 per cent and the United States of America by 40 per cent. This was made possible first by a strong agricultural policy of planned production, backed by legislation. Secondly, the co-operation of the farmers or producers themselves was secured through convincing them that such a policy was not only to the national interest but also to their own individual interest. Thus in the U. K. County War Agricultural Executive Committees, comprising mostly progressive farmers and backed by legislation, carried out a policy of planned production which has astounded the world.

Similarly, in the U. S. A. the creation of the Farm Security Administration and the Agricultural Adjustment Administration assisted by the Soil Conservation Service under the Production and Marketing Administration supervised each farmer's needs and arranged for loans where necessary. The F. S. A. went as far as to provide the farmer with additional land if this was absolutely necessary to bring his standard of production up to the proper level.

In the U. K. before the war there were less than 50,000 tractors in operation. By the end of the war this number had been trebled. A vast organisation provided by the State both in the U. K. and U. S. A. arranged for large quantities of fertilizer and other supplies to enable the farmer to carry out the planned production policy of the Government.

MODERN FARMING

The United Provinces Government are not so rich in revenue as the two governments mentioned above but there is no lack of capital in the country for investment in productive agricultural enterprise for which the State should be prepared to give a lead and provide facilities. For example, I believe that partly by cooperative farming, *i.e.*, the pooling of the resources of our *kisan* and partly by the use of modern agricultural equipment and technique to supplement our available man and bullock power, we can as a province aim at a target not of 5,00,000 tons of additional production but more like 5,000,000 tons. Such an achievement is not outside the range of possibility and can only be realised by a revolution in our agricultural policy. Success would mean adding to the wealth of our *kisans* money equivalent of some 150 crores of rupees per annum more than they are getting at present, quite apart from satisfying the demand for a higher standard of living in the shape of more than two square meals a day, better housing, better educational facilities, medical and social amenities and the like. Cooperative Societies are most necessary but we have to get to a stage beyond that. I will endeavour to show briefly by an illustration or two how we should set about attaining so revolutionary an objective.

CONVINCE THE KISAN.

To get our *kisan* to adopt any new or revolutionary technique is most difficult; but show him how to get an extra five maunds per acre of wheat or rice without straining his resources and he will become your disciple for ever. There is much talk these days of co-operative farming and collective farming, of reaching all the targets we aim at by organising multi-purpose co-ope rative societies in our villages and so on. All these are excellent ideas, but we have to go a long way before we can finally convince every *kisan* in the country of the intrinsic value to him of such measures. Find him a machine that will

By a rough calculation this should add another 20,000,000 tons of food to our provincial larder.

Space does not permit of saying in this article all there is to say on the subject, but by the widespread use of tractors another 1,000,000 tons of food could be produced over and above any target achieved by the use of combines and *as a supplement to the man and bullock power available and not by displacing it uneconomically.* The main advantage of the tractor and certain implements such as the disc plough and cultivator lies in (a) rapid and timely preparation of seed bed for our rabi and kharif crops during seasons of the year when the cultivator is very much at the mercy of the weather (b) bringing under cultivation large tracts of virgin land, especially such as is infested with deep-rooted weeds like *kans*, for which the tractor is indispensable. Apart from these advantages, the wheeled tractor can be usefully employed to transport produce to the market.

NEW TECHNIQUES

There is much talk these days of developing our village industries, but few people realise that the cultivator finds it difficult if not impossible at present to spare the time and energy for such development. He is in great need of relief through the use of tractors and combines. I maintain that the use of modern agricultural equipment and technique such as is briefly described in this article is not only desirable but indispensable if we are to make any substantial headway in the development of rural industries.

Apart from such industries, the cultivator at present is unable to give sufficient time and effort to the manufacturing of compost, the collection of bones for manure, the prevention of soil erosion on a large scale, the improvement of his irrigation facilities by the construction of wells, the construction of suitable irrigation channels and the like.

Mixed farming has been proved to be a vital factor in not only raising the economic level of the cultivator but also in providing him with additional nutrition in the shape of milk and milk products. This occupation requires a great deal of time and attention which the cultivator cannot spare unless our rural economy is provided with much needed relief in the shape of modern agricultural equipment.

I submit this ideal of the use of modern agricultural equipment and technique in all seriousness and I write with 35 years of experience as an agriculturist in three provinces of India, in the United Kingdom and in the U.S.A. Nothing short of a complete revolution in our agricultural practices will bring us to the desired goal of better living and prosperity for our *kisans*. It is for the State to initiate such a revolution as part of a farsighted and effective policy of planned production.

MONTHLY AGRICULTURAL REPORT FOR THE MONTH OF MARCH, 1947

I—Season

During the first week of the month under review, there were light showers in some districts and no rain in the rest. During the second and fourth weeks, there were light showers in almost the entire province. During the third week, there were light showers in most districts and no rain in the others. The total rainfall for the month was in excess of the normal in about half the districts of the province, but in defect of the normal in the rest.

II—Agricultural Operations

Harvesting, threshing and winnowing of *rabi* crops were in progress. Crushing of sugarcane for *gur* and factory sugar still continued in some western districts but was practically finished in the rest of the province. Sugarcane and *zaid* crops were being sown. Irrigation of the newly planted sugarcane and *zaid* crops was done in some areas.

III—Standing Crops

and

IV—Prospects of Harvest

The condition of the standing crops and the prospects of outturn have been reported to be on the whole satisfactory except in some areas where the crops were adversely affected by hail-storm and in the western districts where considerable loss to the wheat crop was caused by rust. According to the reports received from the District Officers, the figures of average anna condition (expressed as percentage) of the mango and *mahua* crops for the province are estimated at about 50 per cent. and 63 per cent. of the normal respectively.

V—Damage to Crops

Some damage to the standing crops by hail-storm has been reported from about half the districts of the province. Damage to the wheat crop by rust is reported from a number of districts. However, this damage is not widespread or serious except in the Bulandshahr, Aligarh, Mainpuri, Etawah and Jhansi Districts, where pronounced damage by rust has occurred. Stray reports of attack by insect pests have also been received from a few districts.

VI—Agricultural Stock

The condition of livestock was on the whole satisfactory, although cattle diseases have as usual been reported from a number of districts. The figures for the number of seizures, deaths and mortality from infectious cattle diseases during this and the preceding months are shown in Table 1, which has been prepared from the data furnished by the Director of Animal Husbandry, United Provinces. It would appear from this table that, as compared with the preceding month, there is a pronounced increase in the total number of seizures, an increase in the total number of deaths but a considerable decrease in mortality. No case of seizure or death by Anthrax has been reported during the month as against 6 cases of seizures and 4 of deaths during the preceding month. As regards Haemorrhagic Septicaemia, there was a considerable fall both in the number of seizures as well as deaths but a slight rise in mortality. In the case of Blackquarter, there were 6 cases of seizures and the same number of deaths as against no case of seizure or death in the previous month. As for Rinderpest, there was a pronounced rise both in the number of seizures as well as deaths, but a slight fall in mortality. As regards Foot-and-Mouth disease, there was a highly marked rise both in the number of seizures and deaths and a rise in mortality. There was no case of seizure or death from other diseases as against 99 cases of seizures and 65 of deaths in the previous month.

TABLE 1—*Number of seizures, deaths and mortality from infectious cattle diseases in February and March*, 1947

Diseases	Seizures		Deaths		Mortality	
	February	March	February	March	February	March
Anthrax	6	..	4	..	67	..
Haemorrhagic Septicaemia	74	41	61	37	82	90
Blackquarter	..	6	..	6	..	100
Rinderpest	508	829	256	401	50	48
Foot-and-Mouth ..	908	2,214	1	13	0 11	0 59
Other Diseases ..	99	..	65	..	66	..
Total ..	1,595	3,090	387	457	24	15

N.B.—Mortality = $\frac{\text{Number of deaths}}{\text{Number of seizures}} \times 100$

VII—Pasturage and Fodder

Pasturage and fodder are reported to be generally adequate except in a few districts where there was some scarcity.

VIII—Trade and Prices

In Table 2 are given the average retail prices in rupees per maund of important agricultural commodities at the end of this and the preceding months. It would appear from this table that there was a slight fall in the prices of barley and gram and a slight rise in those of wheat and *arhar dal*. However, the price of rice remained more or less stationary.

TABLE 2—*Average retail prices in rupees per maund of agricultural commodities for February and March*, 1947.

Commodities	Retail prices	
	February	March
Rice	20·045	20·161
Wheat	13·666	13·983
Barley	10·943	13 292
Gram	13·061	12·184
Arhar dal	17·545	18·060

IX—Health and Labour in rural areas

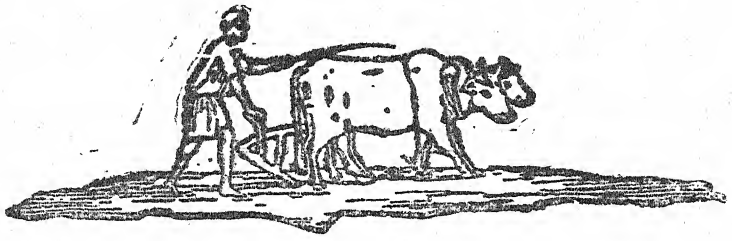
The health of the rural population engaged in agriculture was generally satisfactory except for stray reports of small-pox, cholera and plague from a few districts.

C. MAYA DAS,

Director of Agriculture.

THE

ALLAHABAD FARMER



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FARM COST ACCOUNTS

ALLAHABAD AGRICULTURAL INSTITUTE, FOR 1939-40

BY

S. R. MISRA, B.A., DIP. AGR.

A.—Introduction.

It is not without apology for delay, particularly to the readers of the *Allahabad Farmer*, that I present these Accounts for 1939-40. The accounts for 1938-39 were published in two issues of the Farmer, March and May of 1942. Extra reprints were made later and bound in book form for sale.

These accounts for 1939-40 have been ready for a long time as the accounts for some other years have too, and have been made use of in the Institute. It was because of my inability to find time from routine duties to prepare the notes on the Individual crop accounts and other necessary statements that their publication has been delayed.

I take this opportunity of acknowledging gratefully personal appreciations for the previous publication. We have been continually getting orders for it from places in India and even outside India. It is encouraging to find that that publication has met a need. I am grateful for the reviews, too, and have valued the criticisms. I have seen only two—one in the *Indian Farming* of January,

1943, Vol. IV, No. 1, and the other in the *National Chrsitian Council Review* of January, 1943, Vol. LXIII, No. 1. I shall be grateful to an informant of any other review.

A difference of opinion was expressed in the reviews mentioned above, over certain points. I take this chance of noting down my reactions.

The review in Indian Farming contains this statement "There are, however, certain points on which other workers in this line will not perhaps agree. These are: (1) evaluation of bullocks on market value, (2) charging different rates of interest on value of land and that of buildings, bullocks, and implements and (3) charging home-grown fodder on market value. Further, it is not considered advisable to adopt a man-labour unit regardless of whether it was a man, woman or child. A woman or child cannot be expected to perform work equal to that of a man." Also it points out that on page 52 of the previous publication, "There is a statement that the item of the charge for the 'use of land' takes into consideration in general both the interest and the rental value of land. This seems to have crept in through an oversight and does not seem to be correct because in actual accounts only interest has been allowed."

I have treated in considerable detail in the last publication the justification of market value for marketable farm commodities and I still hold that opinion, although some may disagree with it. The rates of interest in all cases are 5 per cent. except for land which is 2 per cent. The argument for keeping this rate also at 5 per cent. is valid in a way. However, the cost of land and its improvement, in the case of the Institute, has been extraordinarily heavy, as I have already explained in the general statement in the 1939-40 publication. Also, land is a much more permanent asset than buildings. Therefore, a lower rate of 2 per cent. interest on it is hardly unreasonable.

It is true that the interest on the cost of land and improvements at 2 per cent. forms the charge for the 'use of land.' The difficulties of arriving at the rental value of land have been discussed on page 49 to 53 of the previous publication.

It is customery to convert the work of women and children into "man-labour units." I have pointed out the difficulty of recording the man woman and child labour separately for different operations. Further discussion, on this point leads to an aspect of practical farm management. The man-labour unit is supposed to equalise the differences in the work (and also wages) of man, woman and child. But it is based on the false assumption that grown men perform all sorts of work better than women or children. We do not employ women and children regardless of the type of work to be done. A woman is helpless at a plough but she is as, or even more, efficient than a man on an operation such as weeding, gleaning, sieving or picking dockage, and even harvesting. In addition to this, the proportion of boys and women in our annual total of man-days is not large. In regard to wages also a casual man-worker may get the same rate as women and even boys, who had been on the job long before such a casual worker joined work. There are many such self-balancing factors which justify our practice of counting as a man-day one day's labour by man, woman, or child.

An additional reason for continuing the same basis of accounting in this and subsequent reports is that the comparability of the year-to-year records will be maintained in this way. Any departures now would upset this comparability. Moreover, all of the basic figures are there. Different analyses can be applied by any one interested in doing so.

In the *National Christian Council Review* a pertinent question has been raised. "What help will all this (meaning these cost accounts) be to the ordinary farmer?" It answers itself further on by saying, "only as he becomes conscious of the need for keeping careful accounts of the money, labour, equipment, seed, etc., invested in his enterprise will he find anything of value in such a book as this."

Not only in farm accounting but in all forms of agricultural improvement, it is only as the farmer becomes conscious of a need that he will find anything of value in them. Awakening and increasing this conciousness of the ordinary farmer is a constant challenge to writers and workers in the field of agricultural and rural improvement. It is a big problem.

Touching upon a part of this problem I would say that English is an unfit medium of expression to reach the farmer. Yet, a vast knowledge and literature in the field of agriculture has accumulated in English. Hindustani, too, does not serve the purpose adequately as a very large percentage of the farmers is illiterate. Nevertheless, rendering such literature as may be of practical and immediate interest to the farmer into Hindustani is a very great necessity of the present time. Even where there is eagerness to know and improve, proper guidance is badly lacking. The rural worker, whether from Government or public fold, needs to be adequately equipped with practical and up-to-date information necessary to the all-round improvement of agriculture. Publicity has hardly yet been worth the name and propaganda has very largely remained a *tamasha*. Telling only of successes and nothing of failures, of all gains but no losses, does not convince the farmer. It has not gained his confidence or response.

By presenting these accounts it has not been suggested that all farmers should do the same. Of course, they should be encouraged to keep accounts, but in a simple form. This publication is meant primarily for those who are interested in such a study: economists, farm managers and rural workers. When such actual facts and figures have been put out even for a few years, they will provide reliable information of immediate practical interest to rural workers. Do ten ploughings for wheat with the *desi* plough cost more or less than one ploughing with an iron plough plus one or two coats of harrowing, cultivating or discing, in spite of the higher initial cost of such implements? Is it more or less economical to thresh grain by treading over of bullocks than by a threshing machine? Is it more profitable or less for a farmer to take only one crop of *juar* grain in an acre in a year, or to grow a crop of *juar* fodder in that area during the rainy season, maintain thereby a pair of oxen in good condition for six months or sell the fodder for cash, and then to raise another crop after the *juar* fodder on the same land within the same year? These cost accounts are expected to provide an answer to many such questions or combinations of questions for the farmer and for the rural worker. They offer a means of injecting more reality into rural propaganda and publicity.

B.—Annual Statement (1939-40)

I would remind the reader to study the introductory statement in the previous publication (1938-39). It serves as a background for these 1939-40 accounts, as well.

TABLE No. 1.

Capital Invested in the Farm Business, 1939-40(1).

	April 1939.		April 1940.	
A. Fixed Capital		1,92,000	..	1,92,000
Land	80,000	..	..	..
Land Improvements ..	95,000	..	..	..
Buildings	17,000	..	..	..
Oxbarn 5,000/- Silos .. 6,000/- Store .. 6,000/-	..	..	..	..
B. Working Capital		10,065	..	10,333
Work-stock	1,665	..	1,637	
Dead-stock	3,900	..	3,586	
Power driven machinery	..	..	..	..
Cash kept in use ..	4,500	..	5,110	
Total	..	2,02,065	..	2,02,333
Average	..	..	..	2,02,199

(1) *Foot-Note* :—The reader may refer to remarks on page 58 of the previous publication.

In order to arrive at the correct position of the depreciation of the work and the equipment stock the following table is given :—

Work—Stock

	April 1939.	April 1940.	Depreciation 1939-40.
Inventory	1,665	1,637	
Purchase of oxen	287	..	
Sale of oxen	..	100	
	1,952	1,737	215

Dead—Stock

Inventory	3,900	3,586	
Purchases	221	..	
	4,121	3,586	535

Table No. 2.

Farm Receipts, 1939-40.

	Rs.	Rs.
Direct :—		
All Kharif crops	14,365	
All Rabi crops	9,379	
All Vegetable crops	6,680	
All Misc. fodders	4,820	
All Grasses	2,314	37,558
Indirect :—		
Labour	1,625	
Supervision	611	
Bullock work	3,102	
Use of equipment	793	
Manure supply	284	
Irrigation water	616	
Miscellaneous receipts	28	7,059
		44,617

Table No. 3.

Farm Expenses, 1939-40.

	Rs.	Rs.
Labour cost	9,283	
Bullock cost (excluding supervision, labour and interest)	7,824	
Equipment cost	1,370	
Supervision cost	3,776	
Power Machinery cost	2,348	
Seed cost	2,210	
Manure cost	1,801	
Irrigation water cost	2,809	
Marketing cost	1,065	
Miscellaneous cost	632	
Total		33,118
Interest (on Rs. 27,199 at 5 %)	1,360	
Use of land	3,500	4,860
		37,978

Table No. 4.

Some Measures of Success of Farm Business for the year 1939-40

	Rs
Average capital invested	2,02,199
Farm receipts	44,617
Farm expenses	33,118
Farm income**	11,499
Interest on capital	4,860
Labour income†	6,639
If the operators time is worth	5,000
Per cent return on Investment‡	3.21%

**Farm income is the income from capital and operator's labour for one year. Farm receipts less expenses, including any unpaid labour give farm income. In other words it is the net income excluding the interest which has been earned by the operators' capital investment and his professions of farming.

†Labour income is the sum which a farmer gets for his time for one year, after paying all expenses, and after deducting a charge for the capital he has invested. In other words, it is farm income less interest. This sum is known also as operator's labour income, or operator's earnings.

‡Farm income less estimated value of operator's time, expressed as a percentage of the average capital, is known as per cent return on investment.

TABLE

Results on

Crops	Total crop areas	Yield		Value		Cost		Profit and loss	
		Total	Per acre	Total	Per acre	Total	Per acre	Total	Per acre
Juar Grain	..	311·40	8·65						
Juar Fodder	116·00	..	..	8745	75	5018	43	3727	32
Bajra Grain	..	28552·00	351·04						
Bajra Stover	74·25	484·00	6·51	2925	39	2412	33	513	7
Arhar Grain	..	4435·00	59·73						
Arhar Bhusa	89·20	333·75	3·74	1365	15	715	8	650	7
Guara Grain	..	780·25							
Guara Fodder	13·00	24·00	6·00	408	31	310	24	98	8
Maize Ears	..	1415·00	158·60						
Maize Stover	10·40	1723·00	165·67	731	70	494	48	237	23
Paddy Grain	..	1·80	0·90						
Paddy Straw	2·00	363 50	181·75	48	24	74	37	- 26	- 13
Sann-hemp Grain	29·00	5·80							
Sann-hemp Bhusa	5·00	12·00	2·40	106	21	150	30	- 44	- 9
Soya-bean Grain	4·32	1·28							
Soya-bean Bhusa	3·40	4·00	1·20	37	11	79	23	- 42	- 13
Early Bajra ..	14·81	8798·00	594·40	2199	149	722	50	1477	99
Napier grass ..	9·20	10781·75	1171·92	2504	272	561	61	1943	211
Guinea ,, ..	1·09	519 50	519·00	117	107	34	31	83	81
Grasses ..	..	13767 35	..	2263	..	2353	..	- 90	
Sarpat ..	Bundles	1009·00	..	51	.	69	..	- 18	..
Wheat Grain	..	955·17	9·90						
Wheat Bhusa	96·40	..	..	5805	60	5943	62	- 138	- 1
Berra Grain	..	1865·50	1 ·45						
Berra Bhusa	123·80	857·95	6·90	3574	29	5716	46	- 2142	- 17
Early Potato ..	12·69	1690 00	8 80						
Hill Potato ..	10·37	2493·00	196·30	3974	313	2590	204	1384	109
Pumpkin, etc. ..	20·34	1120 00	108·00	1694	163	2063	199	- 369	- 36
Brinjal ..	1·20	237·00	12·00	307	15	316	16	- 9	- 1
Chillies ..	0·60	173·50	144·58	137	115	153	127	- 16	- 13
Cabbage, etc. ..	2·50	10·67	17·78	26	43	49	81	- 23	- 39
Tomatoes ..	1·10	87·15	..	3 2	121	265	106	37	15
Garden Peas ..	0 60	55·70	79·22	176	160	138	125	38	35
Onion ..	0·14	21·12	92·82	42	70	56	93	- 14	- 23
			22·60	22	170	29	206	- 7	- 46
Total ..	608·09	..	..	37558		30309	..	7249	..

Table No. 5 gives farm management data on the crops grown in the year under study. money costs and the labour units, the profit or loss on the full acreage of a crop, and the about 24 per cent of the total crop-income in the year. This indicates that the Institute should form not less than about 50 per cent of the total year's income.

No. 5

Crops '39-'40.

No. of man-days		No. of Bullock-pair-days		Equipment days		Crops	
Total	Per acre	Total	Per acre	Total	Per acre		
4081	35	859	8	818	7	Grain	Juar
						Fodder	
2225	30	675	9	507	7	Grain	Bajra
						Stover	
1208	14	47	..	29	..	Grain	Arhar
						Bhusa	
253	20	81	6	40	3	Grain	Guara
						Fodder	
427	41	56	6	63	6	Ears	Maize
						Stover	
103	52	1	..	1	..	Grain	Paddy
						Straw	
225	45	19	4	17	3	Grain	Sannhemp
						Bhusa	
56	7	25	8	16	5	Grain	Soyabean
						Bhusa	
779	53	110	8	119	8	Fodder	Early Bajra
778	85	9	1	19	2		Napier grass
35	35	..	..	..	..		Guinea grass
4251	..	30	..	30	..		Grasses
110	..	7	..	7	..		Sarpat
4251	45	578	6	594	6	Grain	Wheat
						Bhusa	
3070	25	1365	17	1191	10	Grain	Berra
						Bhusa	
1532	121	162	13	191	15		Early Potato
1071	103	112	11	154	15		Hill Potato
129	6	4	..	11	..		Pumpkin, etc.
125	103	7	5	18	15		Brinjal
44	73	2	3	3	5		Chillies
194	78	14	6	38	15		Cabbage, etc.
152	138	9	8	12	10		Tomatoes
71	141	6	12	9	18		Garden Peas
40	285	..	..	..	..		Onion
25240	..	4221	..	3887	..		Total

It shows whole figures; fractions have been eliminated in most cases. It gives both the profit or loss per acre. It can be seen that the income from no one crop forms more than farming is diversified-crop-farming. For specilized farming one crop or one source of income

C.—FARM WEATHER REPORT
(1939-40)

Month and week.	Rain for the week.	Rain for the month.	Normal for the month for Allahabad.	Remarks.
June, 1939				
2nd week	1·69	..	..	First rain 1·66" on the 8th. Monsoon rain started from the 15th.
3rd "	4·55			
Last "	2·11	8·35	4·85	
July				
1st week	0·18	..		
2nd "	7·06	..		5 days' break.
3rd "	0·26	..	..	
Last "	7·03	14·53	12·12	5 days' break.
August				
1st week	5·10	..		
2nd "	3·39	..	..	
3rd "	3·70	..	..	
Last "	1·75	13·94	11·55	
September				
1st week	0·32	..	..	The heaviest rainfall of the year fell on September 11 to 14th, = 12·05.
2nd "	12·21			
3rd "	0 06	..	..	
Last "	0·26	12·79	5·78	
October				
1st week	0·70	0·70	2·21	Welcome rain.
November	Nil	Nil	0·27	
December	Nil	Nil	0·26	
January, 1940				
3rd week	0·10	0·10	0·74	
February				
1st week	0·23	..	..	
2nd "	0·26	..		Late rain.
Last "	0·02	0·51	0·53	
March				
2nd week	0·59	..	..	
3rd "	0·01	0·60	0·30	Untimely.
April				
3rd week	0·19	0·19	0·14	
May				
1st week	0·01	..	..	
3rd "	0·13	0·14	0·31	
Total ..	..	51·85	39·06	

NOTES

It was a long and hot summer for two and a half months. All the fields had hot weather deep ploughing. The first rain (1·66") fell on June 8, when sowing of Sannhemp for green manure, maize, and *guara* for fodder was begun. The real monsoon rain started from June 15, and sowing of *Juar* fodder, the main *kharif* crop, started in right earnest from the 19th. Then followed a break in the rain which was unfavourable for the proper growth of *Juar*. Lack of uniformity in germination and damage from hoppers resulted in an unsatisfactory yield of fodder.

From the last week of July through August the rain was almost incessant and so *Bajra* could not be sown under favourable conditions.

The heaviest rainfall of the year occurred in the middle of September. It washed away the newly re-built *pucca* dam, north of Indalpur village, and the bund near Tikri.

This heavy rainfall marked the end of the rainy season. Preparation of land for *rabi* crops followed. The rain of 0·70" on October 4, was very timely. A little more would have been better. The *rabi* crops needed a rain in January very badly, but the rain came late—by the middle of February—attended by cloudy weather. This rain was good for some crops and harmful for others. The year was not favourable for unirrigated crops such as gram, and barley and linseed.

The year was free from hailstorm and frost. Rain in the middle of March interfered with the *rabi* harvest. Fields were wet and the harvested crop had much wet earth on its roots, as a result of which threshed grain and especially *bhusa* had a lot of dirt.

The rainfall in the year was above normal by 12·79 inches, and it was 3·81 inches higher than last year, but it lacked in uniformity and timeliness. So, this year agriculturally was not so good as last year.

D Individual Labour and Crop Accounts

It may be noted here that all the 'operating' accounts such as the bullock and equipment accounts have not been given in what follows now. For this reason the totals of certain items in the foregoing tables may not be found to be the same as the totals secured by adding the figures of only the individual 'productive' or crop accounts given in the following pages. The other operating accounts not given in the following pages are the manure stock, roughage stock, supervision, store accounts, and the like.

More interesting studies can be tabulated and graphed from the figures but they have been intentionally postponed to a time when figures for more years will have been made available.

Summary of Labour Account, April 1939 to March 1940

Items of expense	Permanent Man-days	Temporary Man-days	Total Man-days	Amount Paid Rs. a p.
Employment of labour and payment of wages in:—				
April 1939 ...	446	2,586	...	838 0 6
May 1939 ...	515	1,439	...	611 11 9
June 1939 ...	507	1,111	...	534 1 3
July 1939 ...	499	1,945	...	715 8 6
August 1939 ...	488	2,184	...	774 0 9
September 1939	464	2,385	...	814 12 0
October 1939 ...	472	2,330	...	866 14 6
November 1939	480	2,884	...	928 13 6
December 1939	486	2,628	...	877 7 0
January 1940...	476	2,144	...	765 0 0
February 1940	443	1,658	...	645 10 0
March 1940 ...	472	2,878	...	899 0 9
Miscellaneous expense ...	...	...	...	12 0 0
TOTAL ...	6,748	26,132	31,880	9,283 0 6

Items of expense	Permanent Man-days	Temporary Man-days	Total Man-days	Amount Paid Rs. a. p.
RECEIPTS				
Use of labour on:				
Crop-accounts	...	...	27,161	7,652 13 0
Non-crop accounts	...	...	4,719	1,625 2 0
TOTAL ...	...	...	31,880	9,277 15 0
BALANCE, DEFICIT ...	...	...	...	5 1 6

NOTES

See notes on labour for 1938-39.

This year also the relation between the employment of the permanent and the casual labour on the farm is practically the same as last year except that the total man-days employed is less this year by about 2000. This is accounted for by the fact thal from last year local village folks have been introduced on the farm to clean weeds and grasses in return for which they get a share in the cleaned stuff. They are not paid cash wages. As such, this labour does not appear in the figures in this table.

Before last September the cost of labour had to be adjusted to different operations at the end of each month. This was certainly a tedious job requiring a lot of time. This method was changed. The daily charging rate for each monthly man was worked out and fixed, based on the figures for the last five years; the daily charging rate for casual labour was set by the daily wages. The method of indicating men present by dots was replaced by putting the number of operations at which they worked. Before calling roll, the daily operations performed on the farm and the number of labourers present on each operation are recorded and each operation given a number in serial order. In this way, the adjustment of labour instead of being a monthly became a daily feature since last October.

Our one fear about this new system was that the total amount paid in wages and the total daily recovered by adjustments may differ greatly But the result has been quite satisfactory As seen on the back, the difference between the amount spent and the amount recovered by adjustment is only Rs. 5-1-6.

Summary of Bullock Account, April 1939 to March 1940.

Items of expense	Quantity Mds. Srs.	Amount Rs. a. p.
Grain feed	725 0	1,954 4 6
Grinding feed (725 mds.)	...	96 7 6
Wheat bran	366 0	777 12 6
Oil cakes	366 0	707 12 9
Salt	27 18	79 3 6
Silage	8,350 0	2,717 11 3
Grasses	5,371 5	720 15 0
Misc. roughage feed	2,043 2	175 7 9
Water (2,03,000 gallons)	...	152 4 0
Man labour (1,656 man days)	...	643 6 6
Shoeing cart bullocks (126) and he-buffs (194).	...	133 8 0
Repairing stanchions, etc	...	45 6 6
Misc. supplies	...	38 11 9
Medicines	...	14 14 0
Depreciation	...	214 15 0
Supervision	...	258 12 0
Use of barn and stanchions (Rs. 5,000 at 5 per cent)	...	250 0 0
Interest on average inventory (Rs. 1,651 at 5 per cent.)	...	82 8 9
Total cost	...	9,059 1 3

Items of expense	B. P. days	Quantity Mds. Srs.	Amount Rs. a. p.
RECEIPTS			
Use of bullock labour on :			
Crops account	4,563	...	5,726 7 0
Non-crop account...	2,253	...	3,101 13 0
Fresh manure	...	...	400 0 0
Total ...	6,816	...	9,228 4 0
Balance, surplus	...	...	169 2 9
Cost of up-keep per pair of bullocks at work per day (Rs. 9,059 divided by 6,816 pairs)	...	...	1 5 3

NOTES

Roughage and concentrate feeds cost about 40 per cent. each of the total cost; expenses other than the above two items come to about 20 per cent.

We maintained an average of 52 bullocks throughout the year. Of these, about 72 per cent. were engaged in work, which is 6 per cent. higher than last year. This six per cent. increase in the employment of bullocks was in the direction of field work, as the number of bullocks employed in non-crop work is practically the same this year as it was last year.

Summary of $\frac{\text{Equipment}}{\text{(Implements)}}$ Account. April 1939 to March 1940.

Items of expense	Equip-days	Rate Rs. a. p.	Amount Rs. a. p.
All repairs and minor replacements on all implements.			522 3 3
Depreciation 1939-40			233 0 6
Interest on the average inventory value Rs. 2,278/8 at 5 per cent			113 14 9
TOTAL COST			869 2 6
RECEIPTS			
Use of ploughs	1,866	0 3 0	344 5 0
,, rooters	640	0 5 0	198 0 0
,, harrows	364	0 4 0	87 8 0
,, cultivators	247	0 4 0	55 2 0
,, scrapers	993	0 2 0	115 6 3
,, seeds-drills	61	1 0 0	61 0 0
,, spouts W. W.	97	0 2 0	12 2 0
,, corn planter	9	0 8 0	4 8 0
,, bullock-disc	18	0 2 0	2 4 0
,, iron-roller	1½	0 8 0	0 12 0
,, hay-rake	4½	0 6 0	2 4 0
,, grass-cutter	6	0 8 0	3 0 0
TOTAL	4,307	..	886 3 3
BALANCE, SURPLUS	..	..	17 0 9

NOTES

See the notes for t he year 1938-39.

This year, due to war, the price of iron went up, and so the implements were not depreciated so much as in the past. This fact accounts for the lower total working cost of implements this year. Nevertheless, the repairing cost is practically the same as last year.

In regard to the use of implements we find that in comparison with last year the use of the U. P. plough with rooter attachment, and of cultivators, has doubled. The moldboard ploughs were also used more. As a whole, the use of implements rose higher by 11 per cent. than last year. Tractor discing was not used this year for seedbed preparation for *kharif* crops.

Summary of $\frac{\text{Equipment}}{\text{(Bullock-carts)}}$ Account, April 1939 to March 1940.

Items of expense.	Cart-days	Rate	Amount
			Rs. a. p.
All repairs and minor replacements on carts, and grease.	..	.. ..	312 13 0
Depreciation 1939 40	..	.. ..	302 3 9
Interest on the average inventory value Rs. 1,464/8 at 5 per cent.	..	.. ..	73 3 6
TOTAL COST ..	..	..	688 6 3
RECEIPTS			
Use of carts (2-bullock) ..	878	-/10/- ..	548 12 0
,, ekki carts (1-bullock) ..	1,315	-/4/-&-/6/- ..	424 11 6
,, thela carts	72	-/2/- ..	9 0 0
,, water cart	1	-/1/- ..	0 1 0
TOTAL ..	2,266	.. ..	982 8 6
BALANCE, SURPLUS ..	..	.. ..	294 2 3

NOTES

See the notes for the year 1938-39.

This year, due to the war, the value of iron rose, so the carts were not depreciated so much as in the past. The amount of repairing charges is also much less. Thus, due to the reduction of cost, the carts account shows a high surplus. Otherwise, the total of cart-days at work is practically the same as last year, although the use of big (2-bullock) carts has gone down and that of *ekki* (1-bullock) carts has gone up.

Summary of Juar* Account 1939-40.

Area 116.00 .. { Irrigated .. 48.40 Acres. / Unirrigated .. 67.60 Acres.

Items of expense	Man-days	Bullock-pair-days	Equipment kind	Equipment days	Cost Rs.	Cost a.	Cost p.
Manuring							
Manure	107	25	C	50	82	13	0
Preparatory tillage. Dry weather ploughing ..	340	335	P	193	578	7	0
Preparatory tillage. Other bullock operations..	221	220½	I	220½	385	14	0
Sowing	33	58½	H & D	58½	128	11	0
Seed 47 maunds and 2 seers ..	..	..	..	..	117	2	6

* Andropogon sorghum.

Items of expense	Man-days	Bullock-pair-days	Equipment kind	Equipment days	Cost Rs.	a.	p.
Irrigating	169	3½	P	3½	57	15	0
Irrigation-water 48.34 acres ..	..	..	..	..	231	0	0
Weeding and roguing	280	½	..	1	75	14	0
Cultivating and earthing-up (*juar* in lines).	24	12	C1	12	25	1	0
Harvesting and hauling fodder ..	1,764	27½	C	86	580	2	0
Plucking and hauling *juar* heads ..	288	6	C	12	80	11	9
Threshing grain	82	60	..	..	93	10	0
Watching	433	..	..	..	135	13	0
Hauling some fodder to market ..	238	89½	C	180½	224	0	3
Marketing of fodder	..	..	..	..	71	8	6
Supervision	..	..	..	..	604	0	0
Hauling *juar* husk	2	¾	C	¾	1	11	6
Interest on Rs. 2,751/11/9 @ 5% for 4 months.	..	..	..	..	45	13	0
Use of land	..	..	..	..	750	0	0
TOTAL ..	4,081	858¾	..	817¾	5,017	11	6
Per Acre	35	7½	..	7	43	4	0

RECEIPTS	Yield Number	Mds.	Srs.	Rate per md.	Value Rs.	a.	p.
Juar weedings	..	384	31	-/1/7.2	38	6	6
„ fodder (green)	..	24,270	..	-/4/2·3	6,359	3	6
„ *karbi* (dry fodder)	..	3,813	..	-/6/1·7	1,463	8	9
„ grain	..	311	16	2/12/	856	5	6
„ husks (*bhusa*)	..	84	..	-/5·100	27	0	0
TOTAL ..	..	28,863	7	..	8,744	8	3
Per Acre	..	..	..	..	75	6	0
Balance, surplus	..	..	..	..	3,726	12	9
„ per acre	..	..	..	..	32	2	0

NOTES

The details of the area are:—Irrigated *juar* fodder 48 acres, unirrigated fodder 32 acres, and unirrigated grain *juar* 36 acres, with which *arhar* was sown mixed. Of the total area under *juar* about 12 acres were sown in lines and the rest broadcast.

Manuring was done in part of field No. 2 (10 acres) costing Rs. 277-13-0, in field No. 14 (10 acres) costing Rs.283-14-0, and field No. 8 (part area trenched with manure) costing Rs. 268-10-0. The above are the amounts adjusted to the *juar* crop, not the full cost.

Weeding was done in parts of fields Nos. 2, 16, 17 only.

The figures of cost of production, gross income and balance per acre are practically in line with those of the last year.

The average yield of green fodder per acre of both the irrigated and unirrigated area, harvested from July to October, works out to about 303 maunds. The average yield per acre of the irrigated area only works out to about 380 maunds as against 427 maunds of last year and about 22 per cent. higher than the above average. The average yield of green fodder per acre of the unirrigated area is about 190 maunds which is exactly half of the average on the irrigated area. It is necessary to mention here that half of the unirrigated area became out of irrigation only last year. The average yield of *juar*, *karbi* or stover which was allowed to produce grain heads, works out to 106 maunds per acre as against 92 maunds last year.

Field No. 11 (5·50 acres) was sown practically half and half to *juar* in lines and broadcast. The *juar* in lines was sown in the middle of April and the broadcast two weeks later. They were harvested in the first week of July when naturally fooder was very high in moisture content. The yield of green fodder was very high, giving the average of 780 maunds per acre This is one of the sullage—irrigated and most fertile fields. The yield of *juar* in lines per acre works out to about one and a half times the yield of broadcast. The yield of seasonal fodder *juar* in another irrigated fertile field works out to 440 maunds per acre. There were some other fields too, both irrigated and unirrigated, under early and seasonal *juar* fodder, which were sown in lines but it is regretable that their separate yields were not properly recorded and so it is not possible to say anything further about the difference in the yield of fodder of *juar* sown in lines and broadcast. From observations, however, it can be said that the stand of drilled *juar* was very satisfactory in general and in many cases better than the broadcast.

The figures on grain or seed *juar* seem to throw more light on the aspect treated in the above paragraph. A part of a field, which was 4 acres, was sown to *juar* in lines 2 feet apart and one row of *arhar* after every two rows of *juar*. The yield of *juar* stover in this plot works out to 175 mds. per acre, which is 65 per cent. higher than the average (106 maunds) as stated above. This plot was, practically identical with the rest of the area under grain *juar*. The stand of the crop all over the grain *juar* area seemed to be less thick than before. The yield of grain works out to nearly 9 mds. per acre as against 2 mds. 24 seers last year. I think this was the best yield of *juar* grain in many years. Grains were allowed to mature properly before harvesting. The grains of the row *juar* were not threshed separately. So the comparative yields of grain are not known. However, it was quite noteworthy that the grain heads in row *juar* were much superior to those in the broadcast seed *juar*. The effect of this improvement in the grain *jaur* crop was, I think noticeable even further. We did not have complaint against germination of *juar* seed the next year.

Out of the total yield of fodder 19 per cent. (5,180 maunds) was sold in the market; it fetched about 22 per cent. of the total value. The cost of marketing forms about 17 per cent. of the value of fodder sold. In other words, the cost of marketing comes to nearly 11 pies per maund of fodder sold.

Summary of Bajra* Account, 1939-1940.

Area 74·25 Acres — Irrigated .. 6·75 Acres; Unirrigated .. 67·50 Acres

Items of expense	Man-days	Bullock-pair-days	Equipment kind	Equipment days	Cost Rs.	a.	p.
Manuring	3	1½	C	3	3	9	0
Manure (F. 16 A)	..	..	..	..	25	0	0
Preparatory tillage — Dry weather ploughing ..	194½	194½	..	140	336	2	0
Preparatory tillage — Other bullock operations ..	234½	233	..	233	410	2	6
Sowing	66	41½	..	41½	84	13	0
Seed 7 maunds and 3 seers ..	..	..	..	..	18	1	0
Irrigating	13	1	..	1	5	10	0
Irrigation-water	..	..	..	..	64	5	0
Cultivating	39	38½	..	38½	71	9	0
Harvesting and hauling green & dry fodder. ..	597½	19	..	29½	189	0	0
Harvesting grain heads	479½	9½	..	17½	126	7	0
Threshing „ „	181	135	..	..	215	6	0
Watching	414	..	..	..	104	11	0
Hauling threshed heads and husk ..	3	1½	..	3	3	9	0

* Pearl Millet—Pennisetum typhoideum.

Items of expenses	Man-days	Bullock-pair-days	Equipment kind	Equipment days	Cost Rs.	a.	p.
Supervision	..	..	.	..	386	0	0
Interest on Rs. 1,039/8/- at 5 per cent for 4 months.	..	..	..	..	17	5	0
Use of land	..	..	..	..	400	0	0
TOTAL	2,225	675		507	2,411	10	0
Per Acre	30	9		7	32	8	0

RECEIPTS	Yield Number	Mds.	Srs.	Rate	Value Rs.	a.	p.
Bajra (green) fodder	..	1,869	..	3/3·9	388	0	3
„ Stover	..	4,305	..	4/4	1,165	15	0
„ grain	..	484	..	2/12	1,331	0	0
„ husk	..	130	..	..	40	0	0
TOTAL . .	..	6,788	..	..	2,924	15	3
Per Acre	..	..	..	..	39	6	3
Balance, surplus	..	..	..	..	513	5	3
„ per acre	..	..	..	..	6	14	3

NOTES

Arhar is also taken with *lajra* as a catch crop.

Bajra, where it lost Rs. 5-5-0 per acre last year, paid net Rs. 6-14-3 this year. It was grown on better land this year than last year. The increased yield is also partly due to the inclusion of some fodder *bajra*, of which the income per acre Rs 57-5-0 is one and a half times that from grain *bajra* (Rs. 37·6) The income from grain *bajra* itself this year is more than twice that of last year. The yield of both grain (7·17 mds) and *karbi* (68·7 mds.) is twice that of last year. This year the price both of grain and *karbi* was higher by 13 and 33 per cent respectively than last year.

The cost of production per acre this year was also higher than last year by about 29 per cent.

Summary of Arhar* Account, 1939-1940.

Area .. 89·20 Acres Unirrigated

Item of expense	Man-days	Bullock-pair-days	Equipment kind	Equipment days	Cost Rs.	a.	p.
Sowing	6	3	..	3	6	3	0
Seed 12 maunds, 13 seers at Rs. 3 a md. ..	..	..	..	..	37	0	0
Harvesting and Hauling	374	19½	..	21½	113	7	9
Threshing	521½	29	..	1½	161	0	9
Basket and khanchi making ..	184½	..	..	..	40	3	3
Binding stalks into bundles	22½	..	..	..	5	12	0
Hauling to market	7½	1½	..	2½	4	14	3
Marketing	..	..	..	..	2	14	0
Watching	92	..	..	..	31	0	0
Supervision	..	..	..	..	171	0	0
Int. on Rs. 567/10/- at 5 per cent for 5 months. ..	..	..		..	11	13	0

*Cajanus indicus

Items of expense	Man-days	Bullock-pair-days	Equipment kind	Equipment days	Cost Rs.	a.	p
Use of land	..	..	..	..	130	0	0
TOTAL ..	1.208	46¾	..	28½	715	4	0
Per Acre	13½	½	..	..	8	0	3

RECEIPTS

	Yield Number	Yield Mds.	Rate Srs.	Rate ..	Value Rs.	a.	p
(*Bhusa* leaf and pod husk)	..	780	10	..	390	2	0
Stalks	316	..	..	..	79	0	0
Baskets	156	..	..	..	15	10	6
Grain	..	333	30	..	879	7	3
Green plants	..	3	..	..	6	0	0
TOTAL ..	472	1,117	..	..	1364	9	9
Per Acre	5	12	20	..	15	4	9
Balance, surplus	..	..	..	..	649	5	9
„ per acre	..	..	..	..	7	4	6

NOTES

This pulse is a catch crop. Thirty-seven acres was sown mixed with seed *juar*, and the rest mixed with seed *bajra*.

See the accounts and notes for 1938-39, which will show that this crop has given better results this year.

Summary of Guara* account, 1939-40.

	Acres		Acres
Area 13·00 ..	Irrigated ..	..	1·00
	Unirrigated ..	..	12·00

Items of expense	Man-days	Bullock-pair-days	Equipment kind	Equipment days	Cost Rs.	a.	p
Preparatory tillage — Dry weather ploughing F 10, Ry. siding.	26	26	R	13	44	11	0
Preparatory tillage — Other bullock operations	12½	12½	I	12½	21	14	6
Sowing	11	10½		10½	19	4	0
Seed 8 mds. 23 srs. at Rs. 2	..	..		..	17	2	6
Irrigating F. 17	1	..		..	0	5	0
Irrigation-water 0·95 acres	..	..		..	6	0	0
Harvesting and hauling	140½	1	C	1	35	1	9
Threshing grains	27	29		..	42	5	0
Selecting seed	10	..		..	1	15	0
Watching	20	..		..	7	0	0
Hauling husk	5	1¾	C	2½	4	12	6
Supervision	..	..		..	38	0	0
Interest on Rs. 130/4/6 at 5 % for 3 months	..	..		..	1	10	0
Use of land	..	..		..	70	0	0
TOTAL ..	253	80¾		39½	310	1	3
Per Acre	20	6		3	23	13	6

*Cluster Bean—Cyamopsis Psoraliodides.

RECEIPTS	Yield Number	Yield Mds. Srs.	Rate	Value Rs. a. p.
Green fodder—9 ac.		1,405 0	-/4/-	355 3 0
Grains—4 ac.		24 0	2/-	48 0 0
Bhusa		10 0	-/8/-	5 0 0
TOTAL				408 3 0
Per Acre			..	31 6 3
Balance, surplus		..	..	98 1 9
„ per acre		..	..	7 8 9

NOTES

See the note on Guara Crop for the year 1938-39

In comprison with the figures for last year the cost of production per acre this year. for Guara has gone down by about 23 %. While there was a deficit balance of Rs. 9-11-9 per acre last year, we have a surplus balance of Rs. 7-8-9 per acre this year.

The average yield of green fodder works out to 156 maunds this year against 332 maunds last year. One of the main reasons of the average yield of guara fodder going down so much this year is the inclusion of 2·5 acres of the poor unirrigated railway siding land from which guara was cut green. The per acre income from green fodder works out to Rs. 40 as against Rs. 65-10-0 last year.

There seems to be a slight improvement in the yield of grain this year over last year However, the income from the grain crop still is eaten up by its threshing cost.

Summary of Maize account, 1939-40.

	Acres
Area 10·40 .. Irrigated ..	9·70
Unirrigated ..	0·70

Items of expense	Man-days	Bullock-pair-days	Equipment kind	Equipment days	Cost Rs. a. p.
Manuring about 1·5 ac. in 16 A ..	3	1½	C	3	3 9 0
Manure compost, 25 Ekki loads ..	..	..	..	..	25 0 0
Preparatory tillage—bullock operations ..	29	29	1	29	50 11 0
Sowing	26½	11½	Pl.	11½	26 7 0
Seed 3 maunds, 1 seer	..	..	..		23 9 6
Irrigating	33	..	..		10 7 0
Irrigation-water	..	..	..		74 13 0
Weeding and roguing	22	1	H	1	7 12 0
Cultivating and earthing-up	14	6	Cl	6	13 3 0
Harvesting and hauling ears	38½	..	..		9 14 6
Hauling and harvesting stover ..	113	3½	C	6	39 4 0
Husking seed-ears	5	..	..		1 13 0
Watching field 100 and General 20 ..	120	..	..		34 6 0
Hauling to market-ears	28	3	C	6½	12 0 3

Items of expense	Man-days	Bullocks-pair-days	Equipment kind days	Cost Rs. a. p.
Marketing ears	..	..	..	24 5 9
Supervision	..	..	..	65 0 0
Interest on Rs. 265 at 5 % for 3 months ..	..	..	..	2 3 3
Use of land	..	..	..	70 0 0
TOTAL ..	427	55½	63	494 6 3
Per Acre	41	5·4	60·0	47 8 1

RECEIPTS	Yield Number	Mds	Srs.	Rate Mds.	Value Rs. a. p.
Weeds and grasses	..	151	30	10	15 4 9
Maize ears	..	..	..	..	283 13 3
Maize stover	..	1,723	0	4	431 7 0
TOTAL ..	..	..		..	730 9 0
Per Acre	..	..		..	70 4 0
Balance surplus	..	..		..	236 2 9
„ per acre	..	..		..	22 15 3

NOTES

See paragraphs 1, 2 and 6 of the notes on Maize crop of 1938-39.

The cost of production per acre is slightly lower than last year. The surplus balance per acre is about three times as much. This is because some fields failed last year, whereas this year no field failed except F. 12-B which was a part failure only.

The higher income this year is due to more stover. The income from ears is rather less than last year. We may find its explanation partly in the seed rate. This year the seed rate was higher than that of last year. This shows that within certain limits a higher seed-rate results in a higher yield and a higher income from maize stover, whereas a lower seed-rate goes with higher yield and income from maize ears. Also maize stover was sold at 0·7 annas less per maund last year.

About Rs. 52 worth of maize ears were disposed of on the Farm and the rest (Rs. 231 worth) in the market. The marketing cost comes to about 16 per cent. of the value of maize ears sold in the market.

Summary of Paddy Account 1939-40

Acres.

Area 2·00 .. { Irrigated .. 2·00 (Acres)
Unirrigated .. ×

Items of expense	Man-days	Bullock-pair-days	Equipment kind days	Cost Rs. a. p.
Sowing	1	1	H 1	1 13 0
Seed 1 maund and 14 seers at Rs. 2	..	..	..	2 11 8
Irrigating	10	..	..	4 1 0
Irrigation-water	..	..	..	12 12 0
Harvesting and hauling	33	..	..	2 9 0

Items of expense	Man-days	Bullock-pair-days	Equipment kind days	Cost Rs. a. p.
Threshing	1	..	..	0 4 0
Watching	5	..	..	1 10 0
Supervision	..	..	..	15 0 0
Interest on Rs 48-5-3 at 5 per cent. for 2 months.	..	..	..	0 6 6
Use of land	..	..	..	14 0 0
TOTAL ..	103	1	1	74 2 9
Per Acre	52	..	..	37 1 3

RECEIPTS	Yield Number	Mds	Srs.	Rate	Value Rs. a. p.
Green crop and mixed weeds	..	363	20	2/-	44 6 0
Paddy	..	1	30	2/-	3 8 0
TOTAL ..	..	..		..	47 14 0
Per Acre	..	..		..	28 15 0
Balance, deficit	..	..		..	26 4 9
„ per acre	..	..		..	13 2 3

NOTES

See the notes for paddy crop for 1938-39.

The loss this year on the crop is much less than that of last year. Still the position remains the same. The weeds were so thick that most of the crop had to be cut with them and was fed to stock

Summary of Seed Sannhemp* Account 1939-40.

Area 5·00 Acre .. Unirrigated

Items of expense	Man-days	Bullock-pair-days	Equipment kind days	Cost Rs. a. p.
Dry weather ploughing ..	9	9	R 9	16 0 0.
Sowing	2	2	H 2	3 8 0
Seed 3 mds for Rs 6-12 plus cleaning the seed.	31	..	..	13 10 0
Retting for fibre	5	..	..	1 2 6
Harvesting and hauling	104	5½	C 5½	39 1¼ 6
Threshing	55	2	..	15 2 6
Selecting for seed..	8	..	..	1 8 6
Watching	11	..	..	4 0 0
Supervision	..	..	..	26 0 0
Interest on Rs. 71-2 at 5 per cent. for 4 months.	..	..	..	1 3 6
Use of land	..	..	..	28 0 0
TOTAL ..	225	18½	16½	150 1 6
Per Acre	45	3·8	3·2	30 0 6

*Crolaria Juncea

RECEIPTS	Yield Number	Mds.	Srs.	Rate	Value Rs.	a.	p.
Sannhemp seed	..	29	0	2/4/-	65	4	0
„ Bhusa	..	12	6	..	6	0	0
„ Weed seeds	..	10	0	..	10	0	0
„ Fibre	..	5	0	..	25	0	0
TOTAL	..	..	..	..	106	4	0
Per Acre	..	..	..	..	21	4	0
Balance, deficit	..	..	..	..	43	13	6
„ per acre	..	..	..	..	8	12	3

NOTES

See the notes for the crop for 1938-39.
This year the results are better than last year.

Summary of Soyabeans Account 1939-1940.

Area 3.4 Acres Unirrigated

Items of expense	Man-days	Bullock-pair-days	Equipment kind	days	Cost Rs.	a	p.
Preparatory tillage. { Dry weather ploughing F. 9	15	10	R	5	18	13	0
Preparatory tillage. { Other bullock operations F. 9, 20.	4½	4½	I	4½	7	14	0
Sowing	3½	2		2	3	13	0
Seed 1 maund, 7 seers at Rs. 4 per maund	...	...		...	4	11	3
Cultivating	9	4½	Cl.	4½	9	9	0
Harvesting and hauling	9	...		...	2	4	0
Threshing	10	4		...	7	6	6
Watching	5	...		...	1	10	0
Supervision	...	...		...	8	0	0
Interest on Rs. 29/5/3 at 5 per cent. for 2 months.	...	...		...	0	4	0
Use of land	...	...		...	15	0	0
TOTAL ...	56	25		16	79	4	9
Per Acre	7	8		5	23	0	6

RECEIPTS	Yield Number	Mds.	Srs.	Rate	Value Rs.	a.	p.
Soyabeans (seeds)	...	4	13	...	34	9	6
Straw (*bhusa*)	...	4	...	...	2	0	0
TOTAL ...	...	...		...	36	9	6
Per Acre	...	...		...	10	12	3
Balance, deficit	...	...		...	42	11	3
„ per acre...	...	...		...	12	8	9

NOTES

The soyabean crop was generally poor and infested with weeds. The land was poor and unirrigated.

Consequently, the yield was very poor.

Summary of Early Bajra Fodder Account 1939-1940.

Area .. 14.81 Acres Irrigated

Item of expense	Man-days	Bullock-pair-days	Equipment kind days	Cost Rs. a. p.
Bullock operations	85	74	78½	135 13 9
Sowing	40½	13	13	34 13 9
Seed 5 maunds, 38 seers	...	...	...	18 0 0
Irrigating	217	...	...	76 8 0
Irrigation-water	...	...	...	75 0 0
Cultivating and Earthing-up	13	6½	6½	14 7 9
Harvesting and hauling	356	16½	25½	1 9 10 9
Watching	67	...	...	23 6 0
Supervision	...	...	...	119 0 0
Interest on Rs. 368/14, at 5 per cent. for two months.	...	...	...	3 1 3
Use of land	...	...	...	102 0 0
TOTAL	778½	110	118½	722 7 3
Per Acre	52½	7½	8	49 13 6

RECEIPTS	Yield Mds. Srs.	Rate	Value Rs. a. p.
Fodder to A. H. S.	8,994 0	...	998 8 0
„ oxen	114 0	...	27 12 0
„ silo III	4,690 0	...	1,172 8 0
TOTAL	8,798 0	...	2,198 12 0
Per Acre	594 16	...	148 7 6
Balance, surplus	..	...	1,476 4 9
„ per acre		...	98 10 0

NOTES

See the notes for the last year

There is improvement both in the yield and in income. On the average, crops were good over the whole area. The highest yield f r a field was 666 maunds an acre. The cost of production per maund of green fodder is nearly the same as last year.

Summary of Napier Grass Account, 1939-40.

Area .. 9·20 Acres { Irrigated .. 1·30 Acres; Unirrigated .. 7·90

Items of expense	Man-days	Bullock-pair-days	Equipment kind days	Cost Rs. a.
Irrigating (1·3 acres)	13	..	..	3 15 0
Irrigation-water	..	..	..	62 0 0

Summary of Guinea Grass * Account, 1939-40.

Acres.
Area 1.09 unirrigated.

Items of expense	Man-days	Bullock-pair-days	Equipment kind	Equipment days	Cost Rs.	a.	p.
Harvesting and hauling	32	..	..	..	7	14	0
Watching	3	..	..	..	1	5	9
Supervision	..	..	..	..	10	0	0
Interest on Rs. 20 at 5 per cent for 3 months.	..	..	..	..	0	4	0
Use of land	..	..	..	..	14	0	0
TOTAL	35	..	..	..	33	7	9
Per Acre	..	..	..	..	30	11	6

RECEIPTS	Yield Number	Mds.	Srs.	Rate	Value Rs.	a.	p.
Guinea fodder	..	519	20	-/3/3·14	106	0	3
„ roots	..	3	20	..	10	8	0
TOTAL	..	523	..	..	116	8	3
Per Acre	..	479	32	..	106	14	3
Balance, surplus	..	..	..	..	83	0	6
„ per acre	..	..	..	..	80	12	3

NOTES

Being unirrigated this year, the expense, the yield and the income of Guinea grass came down to about one-third of the same items last year. This means that the loss in income was five times the cost of the irrigation water which was cut off.

Summary of Grasses Account, 1939-40.

Items of expense	Man-days	Bullock-pair-days	Equipment kind	Equipment days	Amount Rs.	a.	p.
Cutting and hauling *dub* grass	151	..	..	..	35	1	3
Cutting and hauling *dub* grass from bunds and grounds.	2,771	9½	..	9½	702	11	3
Cutting Railway line grass	1,183	20¼	C	20½	326	9	0
Cutting Railway grasses for sale in the city	15⅓	..	..	..	3	8	0
Contract price for Railway line grass	..	..	..	..	76	3	0
Share of general watching	130	..	..	..	48	0	0
Share of supervision	..	..	..	..	642	0	0
Interest on Rs. 1,903/12/- at 5 per cent	..	..	..	..	23	12	0
Use of land	..	..	..	..	495	0	0
TOTAL	4,250⅓	29¾	..	30	2,352	12	6

*(Panicum maximum).

RECEIPTS	Yield Number	Mds	Srs.	Rate	Value Rs.	a.	p.
Dub grass		359	29	..	140	3	3
Railway line grass		5,067	.	..	783	2	3
Grass from grounds and bunds		7,355	25	..	1,037	4	9
Grass sold in the market		..	..	..	70	10	0
Grass from crop-fields		795	..	..	97	8	0
Excess of cost over value of grass in certain places.		..	..	..	134	0	0
TOTAL		13,767	14	..	2,262	12	3
Balance, deficit		..	..		90	0	3

NOTES

See the notes for 1938-39.

Summary of Sarpat Account, 1939-1940.

Items of expense	Man-days	Bullock-pair-days	Equipment kind	Equipment days	Cost Rs.	a.	p.
Planting	5½	..	..	..	1	11	0
Harvesting and hauling	92½	6	C	6	37	15	6
Watching	9	..	..	..	3	0	0
Hauling to market	3	1	C	1	3	4	0
Marketing	..	..	..	..	1	2	0
Supervision	..	..	..	..	16	0	0
Interest on Rs. 48/11/- at 5 per cent. for 3 months.	..	..	..	..	0	9	9
Use of land	..	..	..	..	5	0	0
TOTAL ..	110	7		7	68	10	3

RECEIPTS	Yield Number Bundles	Mds.	Srs.	Rate	Value Rs.	a.	p.
Sarpat	1,009	..	..	..	50	13	0
TOTAL ..	1,009	..	..	..	50	13	0
Balance, deficit	..	..	..	..	17	13	3

NOTES

See the notes for 1938-39.

Summary of Wheat Account 1939—1940.

Area 96·40 Acres — Irrigated 48·70 Acres; Unirrigated 47·70

Items of expense	Man-days	Bullock-pair-days	Equipment kind	Equipment days	Cost Rs	a	p.
Manuring	72½	28¾	EC	57	76	9	3
Manure	..	..	..	..	535	0	0
Dry weather ploughing	24½	24½	..	20½	42	8	0
Tractor discing	..	..	..	..	289	0	0
Other bullock operations	385½	323¾	..	317½	604	3	6
Sowing	294½	112½	..	112½	259	3	0
Seed	.	..	..	..	494	11	0
Irrigating	313	18½	..	13½	106	15	3
Irrigation-water	..	..	..	..	466	0	0
Weeding and roguing	1,188½	..	..	..	154	10	6
Harvest and hauling	1,173	18½	C	29½	306	11	0
Threshing*	183½	18	..	..	597	8	6
Straw-breaking	55	..	..	..	436	3	9
Watching	471	..	..	..	137	5	0
Hauling and marketing straw	82	35	C	36½	185	5	0
Storing wheat	37½	3¾	..	7½	17	15	3
Supervision	..	..	..	..	633	0	0
Interest on Rs 2,979-12-0 at 5 per cent for 4 months.	..	..	..	..	49	10	9
Use of land	..	..	..	..	550	0	0
TOTAL	4,280½	578¼	..	594	5,942	9	0
Per Acre	44½	6	..	6	61	10	3

RECEIPTS	Number	Yield Mds.	Srs.	Rate	Value Rs.	a	p.
By weedings	..	1250	20	..	128	13	3
„ wheat	..	955	7	..	3,867	4	0
„ mustard	..	2	6	..	8	9	6
„ wheat bhusa	..	1865	20	..	1,800	0	0
TOTAL	..	4073	13	..	5,804	10	9
Per Acre	..	42	10	..	60	3	3
Balance, deficit	..	..	..	..	137	14	3
„ per acre	..	..	..	..	1	7	0

NOTES

See notes for last year.

Whereas there was a small surplus per acre last year, this year it shows a nominal deficit. The cost of production is almost the same, and the price also is almost the same. It is the lower yield of wheat and only the nominal amount of mustard which account for the deficit.

*The main item in this cost was that of threshing wheat by the threshing machine at a cost of Rs. 575-14-9. The remaning amount was the cost of cleaning the threshing floor and of threshing the mustard by oxen.

Of course, the position of the mustard crop was the result of our policy of eliminating it as a mixed crop from wheat. The nominal amount of mustard was from voluntary growth only, from plants which had escaped weeding. We had come to regard mustard growth as effecting the wheat crop adversely, and to look upon its harvesting and threshing as a labour-consuming operation unprofitable in view of the low price. We also saw it as a factor militating against the use of the combine (harvester-thresher) with the introduction of which we are experimenting.

The main reason for the lower yield of wheat is shown in the weather report. The rains in February and also during the harvesting and threshing period were very adverse factors. In addition, a lower supply of sullage water from September to November, and a much higher supply thereafter till March, also contributed to the lower yield, in spite of our having a larger area of irrigated wheat than last year.

Summary of Berra, Barley, Gram and Linseed Account, 1939-1940.

Area — Acres 123·80 Unirrigated.

Items of expense	Man-days	Bullock-pair-days	Equipment kind days	Cost Rs.	a.	p.
Manuring	241	168¾	186	706	3	6
Dry weather ploughing	320	320	169½	550	12	6
Tractor discing	...	...	...	339	12	6
Other Bullock operations	687½	665	656½	1,126	11	9
Sowing	241	126	126	278	1	0
Seed 162 maunds, 8 seers	...	...	...	515	0	6
Harvesting and hauling	1045	21	26	265	13	9
Threshing	157	42	...	535	1	9
Straw-breaking with grinder	45	...	...	257	0	0
Watching	236	...	...	80	0	0
Market linseed	9	¾	2	5	9	0
Marketing straw	50	20	21	81	8	6
Storing	36½	1¾	3½	11	12	9
Supervision	...	...	---	458	0	0
Rope and basket making	2	...	...	6	3	0
Interest on Rs. 2,873·2·6 at 5 per cent. for 4 months.	...	...	...	47	14	0
Use of land	...	...	...	450	0	0
TOTAL	3,070	1365½	1,190½	5,716	2	6
Per Acre	24·79	11·02	9·61	46	2	9

RECEIPTS	Yield Number	Mds.	Srs.	Rate	Value Rs.	a.	p.
Berra	...	3	31	2	...	997	6	0
Gram	...	269	32	...	731	9	9
Barley	...	182	18	...	521	4	0
Linseed	...	74	26	...	290	7	0
All *bhusa*	...	1,090	0	...	1,033	10	0
TOTAL	...	1947	95	...	3,574	4	9
Per Acre	...	15·73		...	28	14	0
Balance, deficit	...	...		...	2,141	13	9
" per acre	...	...		...	17	4	9

NOTES

This year this crop account shows a larger deficit than last year. The area, the cost of production, and the price remain practically the same; it is the lower yield which accounts for the larger deficit. The total yield is lower by about 1,000 maunds than last year. The reason is the adverse weather already mentioned in the notes on wheat.

(1) The details of the above area are: *berra*—40.3, barley -17 8 and gram —65.7 acres. Linseed was sown as a far-spaced inter-row crop over the whole area.

(2) The details of manure are: farm yard manure—301 small cart loads weighing roughly 136 tons and costing Rs. 303-9-3, spread over 6 acres. The labour cost of spreading was Rs. 68-10-0; sheep-folding costing Rs 32 over 2 acres; and green manuring with *sanai* cost Rs. 302 over 14 acres.

(3) Details of seed: *berra* 50 maunds, 32 seers—Rs. 152-6-6, barley 30 maunds, 26 seers—Rs. 92, gram 67 maunds, 5 seers—Rs. 202-8-0, and linseed 13 maunds, 25 seers—Rs. 68-2-0.

(4) Details of harvesting are . *berra*—Rs. 56-8-0, barley—Rs. 72-4-0, gram—Rs. 113-5-0 and linseed—Rs. 23-12-0 (of which Rs. 14-7-0 was the cost of threshing by oxen.)

(5) The actual cost of threshing by the threshing machine was Rs. 470. The rest of the amount was the cost mainly of threshing linseed by oxen.

Summary of Early Potato Account, 1939 1940

Area Acres 12.69 Irrigated.

Items of expense	Man-days	Bullock-pair-days	Equipment kind days	Cost Rs.	a.	p.
Manuring				4	8	0
Manure				25	0	0
Seed bed preparation	117½	108½	107	198	10	6
Sowing	1118½	13¾	14	53	15	3
Seed 59 maunds at Rs. 8/11/3				513	4	0
Irrigating	180	½	½	74	6	3
Irrigation-water				485	3	9
Weeding and Roguing	5½			1	5	3
Cultivating and Earthing-up	163½	14½	14½	61	12	3
Harvesting and hauling	622½	8½	8½	154	4	6
Watching	213			64	6	0
Hauling to market	90	22	51½	86	0	0
Marketing				510	6	6
Supervision				235	0	0
Interest on Rs. 1,725 at 5 per cent. for 3 months.				21	9	0
Use of land				100	0	0
TOTAL	1 531½	162¾	191	2,589	11	3
Per Acre	120½	12½	45	204	1	3

RECEIPTS	Yield Number	Mds.	Srs.	Rate	Value Rs.	a.	p.
By Potato vines	...	877	20	...	27	9	9
,, ,, tubers—1847 maunds 3 seers ...	...	2,493	20	...	3,946	6	6
TOTAL ...	...	3,371	0	...	3,974	0	3
Per Acre	...	...		...	313	2	6
Balance, surplus	...	...		...	1,884	5	0
,, per acre...	...	...		...	109	1	3

NOTES

See the notes for the last year.

In comparision with last year, this year the area and the price are practically the same, the cost of production lower, and the yield and surplus balance much higher. The seed, the marketing and the irrigation are the prominent items of cost of production. It cost about 13 annas per maund to grow potatoes, about 4 annas per maund to sell them, and about 9 annas per maund is the saving. The Marketing Report* on Potatoes has estimated the average cost of marketting potatoes in the U. P. as 9 pies a maund in the pre-war period.

The average yield and acre comes to 196 maunds and 12 seers. The highest yield was 356 maunds an acre in a plot of 1·84 acres and the lowest was 150 maunds an acre. This highest yield far exceeded the previous highest yield of 256 maunds recorded several years ago The Marketing Report on Potatoes gives 145 maunds as an average yield in the U. P. of this variety of potatoes.

There were several factors contributing to the excellent condition of the potato harvest this year, but the rain in the second week of February marked a clear division between the higher yields preceding this rain and the lower yields following it.

For the first time an attempt was made here to find out the difference between the actual production and the final disposition of potatoes. This gives, in other words, the loss in handling and marketing of potatoes. This loss is incurred with every agricultural product which is marketed, but it is very considerable in the case of fresh products like vegetables. To record and find out this loss is not an easy task there are many factors which enter into its determination and which baffle attempts at accuracy

The average loss over the harvest and sale season (January 1 to March 7) was 4·3 per cent. varying from 5 4 per cent. in January, 4.0 per cent. in February, to 3.4 per cent in the first week of March. This sequence follows clearly the stage of maturity of potatoes.

It would be interesting to compare these figures with those which may have been obtained elsewhere in India It is surprising to note that even the Marketting Report referred to above seems to have overlooked the discussion or estimation of this important item of the loss due to shrinkage, etc., in the marketing of potatoes and other vagetables.

Summary of Hill Potatoes Account, 1939-40.

Area .. Acres 10·37 Irrigated.

Items of expense	Man-days	Bullock-pair-days	Equipment kind	days	Cost Rs.	a.	p.
Manuring	47	23¼	E. C.	47	55	4	9
Manure F 16-A, 13, 12 260 Ek. 1 ds ...	...	...	...		260	0	0
Seed bed preparation	39	37⅝		39	68	9	9

*Agricultural Marketing in India—Report on Marketing of Potatoes—Series No. 22.

Items of expense	Man-days	Bullock-pair-days	Equipment kind days	Cost Rs.	a.	p.
Sowing	133½	11	11	64	7	6
Seed 71 maunds, 25 seers at Rs. 5/11/ a maund.	...	...	...	411	11	0
Irrigating	140½	...	...	62	11	3
Irrigation-water	...	...	...	397	0	0
Weeding and roguing	42½	...	...	7	8	6
Cultivating and earthing-up	126	22½	22½	69	2	9
Harvesting and hauling	391	...	...	98	2	0
Watching	113	...	...	35	4	6
Hauling to market	38½	17	34	47	2	0
Marketing	...	...	...	227	14	3
Supervision	...	...	...	161	0	0
Interest on Rs. 1,365/6/ at 5 per cent. for 8 months.	...	...	...	17	1	0
Use of land	...	...	...	80	0	0
TOTAL	1,071	111½	153½	2,072	15	6
Per Acre	103	10½	15	198	14	6

RECEIPTS	Yield Number	Mds. Srs.	Rate	Value Rs.	a.	p.
By potatoes vines	...	135	...	4	3	6
„ potatoes 830 maunds, 13 seers	...	1,120	...	1,689	9	3
TOTAL	...	...	...	1,693	12	9
Per Acre	...	...	...	163	6	3
Balance, deficit	...	...	...	369	2	6
„ per acre	...	...	...	35	8	3

NOTES

See the notes for the last year.

This year the crop has shown a deficit which slightly offsets the high surplus balance given by the early potatoes. Also while the hill potatoes paid better than early potatoes last year, this year the position is reversed.

The cost of production is the same as last year with surprising exactness. The average yield of these hill potatoes comes to only about 108 maunds an acre this year, which is very poor in contrast to the yield of early potatoes this year and also in contrast to the yield of hill potatoes last year. The most adverse factor was, undoubtedly, the rains during the later growing period of the crop, already pointed out in the weather report.

Summary of Pumpkin and Gourds account, 1939-40.

	Acres	
With wheat ..	9·0	
„ potato ..	11·34	Irrigated

Items of expense	Man-days	Bullock-pair-days	Equipment kind days	Cost Rs	a.	p.
Manure	..	..	..	45	0	0
Sowing	6	1	1	3	15	0
Irrigating	49	..	..	20	9	6
Irrigation-water	..	..	..	105	0	0
Cultivating and earthing-up	2	½	½	1	5	9
Harvesting and hauling	5	..	..	1	7	0
Watching and rat control	38	..	..	12	0	0
Hauling to market	29	1¾	9½	12	2	0
Marketing	..	..	..	42	4	3
Supervision	..	..	..	20	12	0
Interest on Rs. 139-5-0 @ 5 % for 3 months	..	..	..	1	12	9
Use of land	..	..	..	50	0	0
TOTAL ..	129	3¼	11	316	4	3
Per acre	6	..	½	15	8	0

RECEIPTS	Yield Number	Mds.	Srs.	Rate	Value Rs.	a.	p.
Pumpkins	1630	147		..	194	13	6
Lauki	4321	90		..	112	8	9
TOTAL ..	..	..		..	307	6	3
Per acre	..	..		..	15	1	6
Balance, deficit	..	..		..	8	14	0
„ per acre..	..	..		..	0	6	0

NOTES

The pumpkin and the gourds were a catch crop with potatoes and wheat. In wheat these were far-spaced, their growth was very sparse and they fruited poorly. In comparison with that in the potato area, the stand in the wheat area could all have been found on not more than two acres. The growth of these in potatoes also was sparse at places. Each of the pumpkin and gourd crops occupied about half of the total area under them.

In case of pumpkins the weight (sale weight) recorded is actual and the number is estimated and *vice versa* in the case of gourds.

Summary of Brinjal account, 1939-40.

Area .. Acres 1·20 Irrigated

Items of expense	Man-days	Bullock-pair-days	Equipment kind days	Cost Rs. a. p.
Nursery expense	..	..	..	11 8 0
Planting	1	½	½	1 0 6
Seed bed preparation	2	2	2	3 8 0
Irrigating	11½	..	..	4 1 6
Irrigation-water 1·20 acres	..	..	..	38 4 0
Weeding	2	..	..	0 8 0
Cultivating	9½	3½	3½	8 4 0
Harvesting and hauling	53½	1	1	15 2 9
Watching and rat control	10	..	..	3 8 3
Hauling to market	35	..	11	9 15 0
Marketing expenses	..	..	..	23 13 3
Supervision	..	..	..	19 0 0
Revenue and Miscellaneous	..	..	..	1 0 0
Interest on Rs. 82 @ 5 % for 3 months	..	..	..	1 0 0
Use of land	..	..	..	13 0 0
TOTAL	124½	7	18	152 9 3
Per Acre	103	5	15	127 2 3

RECEIPTS	Yield Number	Mds.	Srs.	Rate	Value Rs. a. p.
Seed and seedlings	..	..		..	1 15 6
Okra,* F. 13	..	5	18	..	5 0 3
Brinjals	..	168	2	..	130 6 9
TOTAL	..	173	20	..	137 6 6
Per Acre	..	144	20	..	114 8 0
Balance, deficit	..	..		..	15 2 9
„ per acre	..	..		..	12 10 3

*Okra or Lady's Finger was too small an account to be treated separately and so it has been included in the Brinjal or Egg Plant account.

Summary of Chillies Account, 1399-40.

Area... 0.60 Acres. Irrigated.

Items of expense	Man-days	Bullock-pair-days	Equipment kind	Equipment days	Cost Rs.	a.	p.
Nursery expense	..	..	..	..	5	15	0
Planting	1	½	..	½	1	0	6
Seed	..	..	..	..	0	8	0
Irrigating	1½	..	..	..	0	7	0
Irrigation-water	..	..	..	..	7	12	0
Cultivating	3	1½	..	1½	3	3	0
Harvesting	30½	..	..	..	6	5	6
Watching and rat control	4	..	..	..	1	6	0
Hauling to market	4	..	..	1	1	1	6
Marketing	..	..	..	..	3	11	3
Supervision	..	..	..	..	7	0	0
Interest on Rs. 23 at 5 per cent. for 3 months.	..	..	..	..	0	4	6
Use of land	..	..	..	..	10	0	0
TOTAL	44	2	..	3	48	10	3

RECEIPTS	Yield Number	Mds.	Srs.	Rate	Value Rs.	a.	p.
Seedlings	..	..	..	..	0	2	0
Chillies	..	10	27	..	25	7	0
TOTAL	..	10	27	..	25	9	0
Balance, deficit	..	..	..	..	23	1	3

Summary of Cabbage, etc., Account, 1939-40.

Area... 2·50 Acres. Irrigated.

Items of expense	Man-days	Bullock-pair-days	Equipment kind	Equipment days	Cost Rs.	a.	p.
Manuring	..	..	..	..	24	9	0
Preparatory tillage. Tractor discing F. 13	..	..	..	..	8	0	0
Preparatory tillage. Other Bullock operations	6	5½	..	5½	9	12	6
Transplanting	3	..	..	..	0	15	0
Seed	..	..	..	..	27	10	0
Irrigating	22	..	..	..	9	9	6
Irrigation-water	..	..	..	..	45	0	0
Weeding and roguing	27½	..	..	..	7	15	0
Cultivating and earthing-up	11	5	..	5	11	12	3
Harvesting and hauling	27½	..	..	..	6	7	3
Basket making	4	..	..	..	1	0	0
Watching	15	..	..	..	6	0	0

Items of expense	Man-days.	Bullock-pair-days	Equipment kind	Equipment days.	Cost Rs.	a.	p.
Hauling to market	78	3¼	..	27	29	11	0
Marketing	..	..	..	..	30	2	6
Supervision	..	..	..	..	28	11	0
Interest on Rs. 156/2/6 at 5 per cent. for 2 months.	..	..	..	..	1	5	0
Use of land	..	..	..	..	16	0	0
TOTAL ..	194	13¾	..	37½	264	8	0
Per Acre	77½	5½	..	15	105	12	9

RECEIPTS	Yield Number	Mds.	Srs.	Rate	Value Rs.	a.	p.
Cabbage	..	..	..	..	113	8	3
Cauliflowers	..	..	..	..	23	4	3
Knol-khol	..	..	..	..	25	12	6
Brussels sprouts, beet, turnip, etc. ..	..	..	..	..	139	2	0
Seedlings	..	..	..	..	0	2	6
TOTAL ..	..	..	..	..	301	13	6
Per Acre	..	..	..	..	120	11	3
Balance, surplus	..	..	..	..	37	5	6
,, per acre	..	..	..	..	14	14	3

NOTES

The area of the different products included in this account are :—

Cabbage	1.76	acres.
Cauliflower	0.16	,,
Knol-khol	0.18	,,
Beet roots, turnips and carrots	.20	,,
Red cabbage and Brussels Sprouts	0.20	,,
TOTAL ..	2 50	,,

Summary of Tomatoes account, 1939-40

Area .. Acres. 1·1 Irrigated.

Items of expense	Man-days	Bullock-pair-days	Equipment kind	Equipment days	Cost Rs.	a.	p.
Share of nursery	..	..	..	..	10	7	6
Preparatory tillage. Tractor discing, F. 13 ..	..	..	..	..	3	0	0
Preparatory tillage. Other Bullock operations ..	7½	7½	7½		14	8	6
Seed 2 oz.	..	..	..	..	3	0	0
Irrigating	2½	..	..	..	1	0	0
Irrigation-water	..	..	..	..	20	12	0
Weeding and rouging	2	..	..	..	0	7	6
Cultivating and earthing-up	2	1	1		2	4	3

Items of expense	Man-days	Bullock-pair-days	Equipment kind days	Cost Rs. a. p.
Watching and plucking	91	..	..	17 14 3
,, and rat control	36	..	..	9 2 0
Hauling to market	11	..	Th. 3	3 5 6
Marketing	..	..	..	20 1 3
Supervision	..	..	..	23 0 0
Interest on Rs. 86 at 5 per cent. for 2 months.	..	..	..	0 11 6
Use of land	..	..	..	8 0 0
TOTAL	152	$8\frac{1}{2}$	$11\frac{1}{2}$	137 10 3
Per Acre	138	8	10	125 2 0

RECEIPTS

	Yield Number	Mds.	Srs.	Rate	Value Rs. a. p.
Seeds	..	..		..	2 8 0
Seedlings	..	..		..	0 9 0
Tomato	..	87	6	..	172 14 3
TOTAL	..	87	6	..	175 15 3
Per Acre	..	79	5	..	169 14 3
Balance, surplus	..	..		..	38 5 0
,, per acre	..	..		..	34 12 3

Summary of Beans and Peas Account 1939-40

Acres.
Area .. 0·60 Irrigated.

Items of expense	Man-days	Bullock-pair-days	Equipment kind days	Cost Rs. a. p.
Seed bed preparation	5	$4\frac{1}{2}$	$4\frac{1}{2}$	8 13 9
Seed 15 sears	..	..	..	2 4 0
Irrigating	6	..	..	2 7 0
Irrigation-water	..	..	..	9 9 0
Harvesting and hauling	20	..	..	4 14 6
Threshing	$5\frac{1}{2}$	$1\frac{1}{2}$	..	3 2 6
Watching and plucking	34	..	..	6 0 0
Supervision	..	..	..	13 0 0
Interest on Rs. 48/12/ at 5 per cent. for 2 months.	..	..	..	0 6 6
Use of land	..	..	..	5 0 0
TOTAL	$70\frac{1}{2}$	6	$4\frac{1}{2}$	55 9 3
Per Acre	..	..	..	92 9 6

RECEIPTS

	Yield Number	Mds.	Srs.	Rate	Value Rs. a. p.
Bean vines	..	11	0	..	2 12 0
Bhusa	..	36	20	..	9 2 0
Beans (St. Plots)	..	7	24	..	24 2 0
Peas	..	0	24	..	5 13 0
TOTAL	..	55	28	..	41 13 0
Per Acre	..	92	33	..	69 11 0
Balance, deficit	..	..		..	13 12 3
,, per acre	..	..		..	22 14 6

Summary of Onion Account, 1939—1940.

Area 0.14 Acres Irrigated

Items of expense	Man-days	Bullock-pair-days	Equipment kind	Equipment days	Cost Rs.	a.	p.
Manuring nursery expenses	..	..	..	..	1	5	0
Transplanting	14½	..	..	..	4	10	3
Irrigating	1	..	..	..	0	8	0
Irrigation-water	..	..	..	..	1	12	0
Weeding	5	..	..	..	1	15	6
Harvesting and hauling	14½	..	..	..	3	4	3
Watching	3	..	..	..	1	3	0
Hauling to market	2	..	..	1	0	10	3
Marketing	..	..	..	..	2	4	0
Supervision	..	..	..	..	6	1	0
Interest on Rs. 20-3-0 at 5 per cent for 3 months.	..	..	..	..	0	4	0
Use of land	..	..	..	..	5	0	0
TOTAL	40	..	..	1	23	13	3

RECEIPTS	Yield Number	Yield Mds.	Yield Srs.	Rate	Value Rs	a.	p.
Onions	..	..	..	..	22	6	0
TOTAL	..	21	5	..	22	6	0
Balance, deficit	..	..	..	..	6	7	3

NOTES

Notes on Vegetables (Other than Potatoes.)

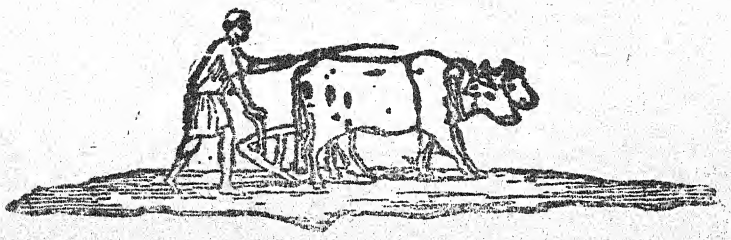
See the special notes on vegetables for last year.

These vegetables, on the whole, have not given much surplus balance. The late rains mentioned in the weather report had a bad effect on all vegetables.

According to the hope expressed last year, yields of vegetables as sent for disposal have been recorded this year. This record could not be as satisfactory as we wanted it to be, yet it has thrown much light where there was none before. We were not able to grapple with the other two problems—the loss of vegetables in the field before they are plucked for sale and the loss between the amount plucked and the amount actually sold. However, we hope to be able to report later on this.

The Mission Press, Allahabad.

THE ALLAHABAD FARMER



VOL. XXI] SEPTEMBER, 1947 [No. 5

Editorial

Although the year 1946-47 was one of continued difficulty in securing adequate staff, equipment, and building materials, it was a year of progress. The reports which we have pleasure in presenting in this number indicate some of the difficulties and accomplishments in the different departments

Some factors which have made it difficult to secure and maintain a proper staff are to be welcomed. The fact that five Indian teachers were studying in the United States caused difficulty, but it promises a better staff in the future. We also welcome the many developments in agriculture and animal husbandry in the country, although they mean increased competition for staff. We are proud of the fact that Mr. N. R. Joshi, a former student and for many years a trusted member of the staff, has been appointed to the staff of the Food and Agriculture Organization of the United Nations, with headquarters in Washington. He had left the Institute in 1945 to accept a responsible position in the C. P.

It was mentioned last year that we had for the first time admitted a double section in the first-year class in agricul-

ture. This was repeated in July, 1947. Even so, only a small percentage of the applicants could be admitted, for the interest in agriculture continues to grow more rapidly than facilities for training. The increased number of students, together with an increased staff to teach them, has put increased pressure on housing and class rooms. In spite of very limited supplies of building material, additions have been made to the hostel and a few residences have been constructed. Crowding and make-shift arrangements continue. Levelling has been completed which will give us a full-sized playing field for the first time.

These developments have been made possible by gifts in the United States and India in recognition of the many years of devoted service of Dr. and Mrs. Higginbottom, the founders of the Institute. Increased costs of building will require much more money, however, to complete the programme which was planned in this connection, and we are sure that there are still many friends of the Higginbottoms who will wish to contribute to this recognition of their service. During the year further progress was made in broadening the basis of the Institute and in September, 1947, an interdenominational Board of Founders was organized in America

We are very sad to have to report the illness of Dr. John L. Goheen, the Principal of the Institute After several months of illness, he and Mrs Goheen flew to the United States in September, 1947, and it now seems that they will not be able to return. Before coming to the Institute in 1945, they had served rural India very effectually for many years in the Southern Maratha Country. In the short period they spent at the Institute they made a large contribution, and they are greatly missed.

W. B. HAYES, M. Sc.,
Officiating Principal.

REPORT OF THE AGRICULTURAL ENGINEERING DEPARTMENT, 1946-47.

MASON VAUGH, B. Sc., A. E.

The year under report will probably go down in the history of the Department as one of the most improbable in many ways that could be expected to happen. It brought frustration, difficulties and encouragements in large quantities each.

We entered the new college year in July, 1946 with only one experienced teacher, other than the head of the department. Mr. S. C. Bhatnagar was still here but expecting to get a foreign scholarship or to accept one of the several appointments being offered him elsewhere. Mr. R. N. Pahalwan and Mr. S. V. Arya joined the staff from the previous year's graduating class, serving through the year. Mr. K. C. Priyadarshi joined as teacher of electrical engineering subjects. In September, Mr. C. M Jacob, B. Sc., Civil Engineer, joined the staff for civil engineering subjects, and, shortly after, Mr. K. P. Misra, B. Sc. in Electrical and Mechanical Engineering, took over the physics and mathematics classes for the rest of the year. Mr. F. J. W. Moraes, B. Sc. Agr., B. Sc. Agr. Engr., joined in November, just in time to take over the duties of Mr. S. C. Bhatnagar before he went on study leave to the U. S. A. Mr. Priyadarshi left in March to take a scholarship for advanced study at the Tata Institute, Tatanagar.

The situation for next year is much more encouraging. Mr. Jacob, Mr. Misra and Mr. Pahalwan are continuing full time. Mr. Arya is entering for the B. Sc. Agr. course, but will continue to give part time to the department, including some teaching. Mr. Jaswant Singh Bali, B. Sc., Punjab University, is joining to take mathematics and physics in the Intermediate and it is expected that Mr. C. V. Paul who has been on war technician training duty for the last several years will rejoin to take over all shop teaching. He has not yet been released, but his release is expected in time for him to join. Hence, all but one member of the department staff will have had experience here and that one member has had experience teaching elsewhere. Mr. Moraes takes the place of Mr. B. D. Sharma as research engineer. Mr. Sharma left the middle of March to take an appointment as Assistant Agricultural Engineer in the Bengal Government Department of Agriculture, Dacca.

The examination results for the year were surprisingly good. The class was known to be a very good class as four had had B. Sc. Agr. and one was B. Sc., Inter. Agr., before joining the engineering course. Eight first divisions were, however, unexpected. We wish we could look forward to a continuance of such standards. It is hoped that the public and students will not get the idea that the course is unduly easy.

Difficulties in getting steel decreased somewhat during the year under report. We received a wagon load of high carbon flats for making shares, and some high carbon sheets. The wagon load of steel shipped from Calcutta in September, 1945, was finally located and delivered in March, 1947. Deliveries of implements during the year totalled over Rs. 15,000 with nearly an equal amount in course of manufacture or in stock at the end of the year, that is, March 31, 1947. Since the end of the financial year, we have delivered some Rs. 7,500 worth of implements and have just as this report is being prepared received further large orders which will bring the total already on order or delivered up to last year's total sales. An encouraging feature is that the new orders are from those districts where large orders have gone in the past. The scheduling of steel orders and of getting deliveries has been a matter of some difficulty, due especially to the uncertainty as to what Government would do. At the beginning of the year, there were rumours and statements by officials of the intention to start a big state-owned implement factory which has made us cautious about building up even normal inventories of steel. The situation is still somewhat obscure, and the necessity for caution still remains.

Some progress in building construction has been possible even though materials procurement has been a continuing nightmare. Twenty wagons of coal dust allotted in the spring of 1946 did not come through. The information that ten wagons were allotted in July to September did not even reach us, even in spite of a personal visit to the office. Fortunately, we have had a small allotment of brick weekly through the Local District Supply Office which has enabled us to continue activities. In addition, we were able to salvage quite a large quantity of brick by dismantling a small building no longer required and the cylinder of an old well, in addition to some unused old foundation.

The success beyond all expectation of the cafeteria mess led us to try to get the new dining room—kitchen arrangement for Hostel No. 2 ready. It was to be a half basement. The basement was dug and construction carried up to plinth level. We were unable to get the steel or cement to put on the ground floor so construction had to be abandoned on that wing and switched to the West wing. The student accommodation in the ground floor of the West wing has been carried up to second floor level, the walls have been plastered and work has been started laying the floor. It is still hoped to have the rooms ready for occupation by the time the third year is admitted. An allotment of steel has just been received which will enable us to resume work on the dining room and it is hoped that the general cafeteria can shift to it sometimes during the fall.

The most outstanding event in the field of new machinery was the use of the combined harvester-thresher in the harvest of the rabi crop. The machine available on loan from the Agricultural Department of the U. P. was not the type which would have been chosen had there been freedom of choice but it was available. It worked well as a header but is not designed for handling heavy straw when cutting low. Some minor adaptations made it possible, however, to use it and made possible the harvesting of about 2/3rds of the Institute crop with it. A canvas tarpaulin fastened at the back and allowed to trail on the ground made possible the saving of most of the straw. It was judged that the loss of both grain and *bhusa* was about the same as that in the fields where hand labour was used in the same season and crop. It was used mainly for wheat but barley and *berra* were also harvested. Its use made possible the completion of the harvest at least two weeks earlier than had been possible in recent years when hand harvesting and a stationary threshing machine was used. This might mean the saving of considerable grain in a season when the weather was unfavourable. A new self-propelled combine which is expected to be a much more suitable type, has been landed in Bombay and is daily expected to reach the Institute. It will be used in the next season in comparison with the present machine. With it, improved arrangements for saving the straw are expected to be possible, resulting in the saving of both cost and time.

Material progress has been made during the year in arrangements for teaching in the department. A new lathe, a drill press, and an electric welder have been added to the

student shop equipment. A beginning has been made toward the setting up of an electric laboratory and it will be nearly ready when college opens in July. During the latter part of the year, the Massey Harris Co., of Toronto, Canada, made a gift of Rs. 820 which has been designated for improving the farm machinery laboratory. They have promised a similar gift for next year. At the beginning of the new financial year of 1947-48, the U. P. Government gave a grant of Rs. 25,000 towards the fitting up of laboratories for teaching hydraulics and the testing of materials. Additional space is urgently needed by the Engineering department as by all the other departments to care for the increasing number of student and for the equipping of laboratory facilities. Particularly more office space is needed and the completion of the student workshop is becoming urgent. Except for the additional space needed in the student workshop, the provision elsewhere for other departments, as envisaged in the Higginbottom Recognition Fund, would amply provide for the engineering department in the space vacated in the engineering building.

Construction during the year of one additional small bungalow and of a block of three staff quarters not only increased the space available for housing staff which was badly needed, but also gave opportunity to experiment with new designs and construction. These new quarters have been favourably commented on by visitors and local people. Construction of one family quarter and of a block of 4 bachelor apartments in connection with the new hostel is continuing this opportunity. In connection with the latter, special attention is given in the design to the possibility of applying forced ventilation or mechanically operated evaporative cooling. The design of these units specially lends itself to an installation in which one fan can supply ventilation, evaporatively cooled air, or possibly heated air in the winter time, as may be required, which can be directed to whatever part of the quarter is being occupied at a particular time.

The availability of a 24" propeller type exhaust fan and Mr. Vaugh's presence throughout the hot season has given opportunity for getting data on the utility of evaporative cooling and its cost. The fan was installed in Dr. Mosher's quarters during the early part of the season and moved to Mr. Vaugh's quarters the latter part of May. It

was installed at the ground floor level in Dr. Mosher's house and in a large *roshandan* (window just under the high ceiling) of a bedroom, which opened on to a second story verandah at Mr. Vaugh's. The large bedroom served by it has remained between 80° and 85° F. throughout May and June, day and night. By opening and closing doors as required, the cooled air from the bedroom can be directed in different directions. When directed out through the bath room, it is possible to bathe and dress in confort. When directed from the bedroom through the dining room and living room, it materially improves the comfort of these rooms though no temperature readings have been kept. With a consumption of some 6 to 8 units of current a day, it has been possible to keep one room comfortable at all times and to ameliorate conditions in two others. Comfortable sleep, on some nights even without a fan going, has been possible inside during a season when both day and night temperatures have averaged high.

The present installation is improvised and apparently inadequate for full effect. Further investigation is under way, but it is anticipated that a really satisfactory installation, with a larger capacity fan, a larger *khas ka tattie* (evaporative cooling mat) and provision for recirculation of the water used, can be made for something between Rs. 350 and Rs. 500. A fuller discussion of the whole matter is under preparation and will be submitted to the "Farmer" for publication in due course, it is hoped in time for people to use the information for next hot weather.

The department has had two interesting indications of the recognition of its work. It has been asked to conduct, in a representative area, a survey of small implements and tools used in agriculture, on behalf of the Food and Agriculture Organisation of the United Nations. Preparations are under way for this and it is hoped that it can be carried out during the 4 months, July to October, 1947. This survey is expected to give interesting and valuable data on various points about which the present knowledge is limited.

The other indication of recognition is that the Indian Council of Agricultural Research has asked us to develop a device to make impossible the adulteration of milk by the deliveryman during the process of delivery. Work on this is under way and it is hoped that a model can be ready for test in early July. The device will not, of course, prevent adult-

ration at the source of the milk, or after delivery in the household.

The profession of agricultural engineering is beginning to win wider recognition. Aside from the men sent abroad for further training in anticipation of employment by provincial governments, at least three provinces have employed graduate agricultural engineers during the year and other offers are being made. States are enquiring for suitable men. Private firms have begun to compete for good men. The large firms dealing in farm machinery have employed qualified men. One province in setting up a new engineering college has included a curriculum in agricultural engineering and will admit students from July, 1947. At least one other engineering college has such a curriculum on paper, though it is not known when students will be admitted.

While the year has had its moments of deep discouragement, it has also provided a large measure of encouragement and satisfaction. Much is still needed to make the Department what we dream it should be. We are making progress towards getting what is needed.

REPORT OF THE DEPARTMENT OF BIOLOGY, 1946-47.

BY

W. K. Wesley, D. Phil.

Dr. E. F. Vestal, was appointed the officiating Head of the Agronomy Department and Dr. W. K. Wesley, took over as the Head of the Department of Biology, Mr. S. R. Barooah, who had submitted his thesis for the degree of Doctor of Philosophy to the Allahabad University and had left for further studies in U. S. A. was awarded the D. Phil. degree. His subject was "the Physiology of Paddy." Mr. L. C. Nott, left during the year and Mr. K. B. Pisharodi, helped in the teaching of Botany.

Botany.

Mr. L. C. Nott's leaving in November of 1946, necessitated some changes in the distribution of the teaching load in the Section. These were accomplished and the work went on.

As was indicated in the Annual Report of 1945-46 (Allahabad Farmer, Vol. XX, 4th July, 1946) the extra class

activities of the Botany Section have tended toward the plant pathological phases of botany. The survey of crop diseases and the isolation and identification of fungi have been special activities. Some of the isolations have been sent to the Mycological section of the Indian Agricultural Research Institute, New Delhi. Several interesting observations were made during the 1946-47 season. There was a complete absence of stripe rust on either barley or wheat in the vicinity of Allahabad. This fact has been previously noted (Allahabad Farmer, Vol. XXI, 3, May, 1947). Pea and Alfalfa rusts were unusually severe. Powdery mildew also caused damage to peas and cucurbits. Maize was injured by a species of *Helminthosporium*, which was considered to be *Helminthosporium turcicum*. The same fungus appeared on jowar and caused some loss of foliage. A species of *Curvularia* also caused some damage to the leaves of jowar, maize and sugarcane. Zonate leafspot (*Taetospora andropogonis*) also caused damage to jowar and at this time (September, 1947) is causing a considerable loss of lower leaves of some varieties of jowar.

Potato root and tuber rotting fungi were isolated and studied in the laboratory and garden. Mr. B. K. Pisharode, was asked to take over the actual experimental work. *Sclerotium (Rhizoctonia) bataticola*, *Sclerotium rolfsii*, *Rhizoctonia solani*, *Fusarium* species and the soft rot organism *Bacterium carotovorus* were among the organisms found. Studies were carried out using *Sclerotium bataticola*, *Rhizoctonia solani* and a species of *Fusarium*, all isolates from diseased roots and tubers.

In co-operation with the Department of Agronomy, initial trials are being conducted with some of the selective weed killing chemicals, such as Stantox (2, 4-Dichlorophenoxyacetic acid), and Sinox (a sodium salt of dinitro-ortho-cresol), kindly furnished for experimental purposes by Standard Agricultural Chemicals, Hoboken, New Jersey, and Methoxone (another acetic acid derivative) sent for trial experimental puposes by the Imperial Chemical Industries, Ltd., Calcutta. Complete reports on the effectiveness of these herpicides will be given later. These trials are under the immediate supervision of Mr S. Upadhyaya of the Agronomy Department.

A continuation of the study of the fungi causing the root rotting of papaya was made during the year. Isolations were made that confirmed the previous findings, *i.e.*, that *Pythium*

species, *Macrophomina phaseoli*, *Rhizoctonia* solani and species of *Fusarium* are the most common pathogens found on the decayed roots. In co-operation with the Horticultural Department experiments are being run in which the effect of organic and inorganic manures on the incidence of the pathogenic fungi in the soil will be tested. A Latin square layout has been used for the design and the work of application of the fertilizers is under the direction of Mr. W. B. Hayes and Mr Theodore Dean of the Department of Horticulture. The experiment will be continued during the life-time of the orchard. Also, in co-operation with the Department of Horticulture, a randomized layout has been designed and two chemical nemetocides applied to the soil as a preparation for planting. The two chemicals, Iscobrome (a methyl bromide mixture) and Iscobrome D (an ethylene dibromide mixture) have been furnished by Innis Speiden & Co., New York. The first application has been made on an old papaya orchard which is badly infected with root rotting fungi and some nemetodes. The nemetocides are also claimed to have some effect on the pathogenic fungi of the soil.

Entomology.

Mr. R. C. Sharma, one of our graduates, took up a special study of the guava pests which he intends continuing when he goes out for further studies abroad. It was reported that mango crop was seriously affected by a very heavy out-break of *Idiocerous* spp., the mango-hopper Trials with D. D. T. and Gammexane are being carried out in the fields in co-operation with the Department of Agronomy.

The Agronomy Department reported that Gammexane D-025 was mixed with talc in the proportion 1 : 50 for treating seeds of cereals, pulses and vegetables against grain pests in our seed store.

In the case of small lots the seeds were spread over a tarpaulin and dusted through the perforated lid of a glass bottle, thoroughly mixing the powder with the seed so as to give it a uniform coating of the powder.

Bigger lots of wheat and other seeds were protected by dusting the floor and walls of the bins before the seeds were dumped in and also sprinkling some of the powder over the top layer of the grain after filling the bins.

This adequately protected the seeds killing all the different kinds of weevils and other insects usually present in the store, such as *Trogoderma khapra*, *Sitophilus oryzae*, *Rhizopertha dominica*, *Tribolium* spp., *Pachymerus chinensis*, *Bruchus* spp., and *Laria affinis*, etc., and also some other small insects like ants and termites. Many dead insects were found in and around the bins a few days after the treatment.

All the seeds thus treated (including those of vegetables) were found practically free from insect damage at the time of sowing. It was, however, observed that moths apparently were not affected by the treatment.

REPORT OF THE CHEMISTRY DEPARTMENT, 1946-47.

BY

A. P. Brooks, M. Sc.

Staff.

The number on the staff remained the same as last year but with some change in personnel. Mr. C. O. Das was granted study leave for two years, and left for America to take up advanced study in Agricultural Chemistry at Ohio State University. Mr. A. P. Brooks remained Head of the Department; Mr. J. C. Gideon took over the classes taught by Mr. Das; and Mr. P. Z. Abraham joined the staff as a temporary teacher to take over the classes previously handled by Mr. Gideon. Dr. B. B. Malvea, of Ewing Christian College, continued to deliver the lectures in theoretical Agricultural and Bio-chemistry for the B. Sc. classes.

Supplies.

For some years the supply situation has been sufficiently critical to warrant mention in the report. During the year under report we received a considerable quantity of war surplus materials purchased from the American Army prior to the conclusion of the agreement by which all remaining supplies were sold to the Government of India. The materials included chemicals, laboratory glassware, and some apparatus such as analytical balances, etc. We were very fortunate to be able to get this material and at reasonable prices. It will all come in very handy, as much of it has been practically unobtainable on the open market at almost any price for several years. In addition to the war surplus materials we were able

to procure in the market most of the other needed supplies, and several experiments which had had to be abandoned for several years due to shortages were resumed, resulting in better preparation of advanced students.

Activities.

The admission of a double section in the first year (Intermediate Agriculture) class added to the already full teaching load. A redistribution of duties enabled this to be handled without additional staff. But the increased teaching load, together with the absence of Mr. Das, curtailed the amount of non-curricular investigations which could be undertaken. Several samples of tallow were examined for a commercial firm, and several samples of feeding materials were analysed for the Department of Animal Husbandry. And there were the usual number of samples of milk or other dairy products to be tested for purity.

The principle non-teaching project undertaken during the year was the handling of the war surplus materials received by the Institute. This was entrusted to the Chemistry Department as an appreciable portion of these materials were scientific supplies. There were over 66,000 lbs. of materials received, involving over 900 separate items and packed in over 700 different containers. The physical task of handling and sorting this material and allocating it to the various departments, and then the clerical work of adjusting the accounts amounting to over Rs. 30,000, was a real job and took all of the spare time of the departmental staff for about five months. But the benefit accruing to all departments of the Institute made it well worth while.

REPORT OF THE DEPARTMENT OF AGRICULTURAL ECONOMICS, 1946-47.

BY

H. S. Azariah, B. Sc. (Ag)., M. Sc.

Personnel—During the year under report, the department had the services of Mr. R. P. Saxena who taught principles of economics to the Intermediate and Indian Dairy Diploma classes. He also had the latter for book-keeping.

Teaching—As usual, most of the work done by the department is teaching. In an attempt to improve the standard

of teaching it was found useful to give frequent short tests of the objective type. These tests not only eliminate the difficulty of expression in a foreign language but also help the teacher to find out whether the students have read the assigned readings. Furthermore, this has helped the students to give up their tendency to fill in pages with irrelevant matter in their examinations. It was also found that a great deal of time could be saved if the students are provided with outlines of lectures and reference materials. These techniques are common in the United States but are not yet widely used in India, probably because of the expense involved. Had it not been for a special private gift from a friend in Watertown, N. Y., this could not have been done. We deeply appreciate the gift.

Syllabus—Once again we have recommended a major change in the syllabus for agricultural economics for the Bachelor of Science degree in Agriculture. Only a third of the syllabus could be changed last time (1942). In order to systematize the syllabus, the word "marketing" was deleted from the introductory paragraph and this eliminated from the syllabus what little there was on marketing. We have now introduced an entirely new paragraph on agricultural marketing.

For some strange reason only those students who were specializing in Agronomy were getting Farm Management, and those who were specializing in Animal Husbandry and Dairying and in Pomology did not have either Farm Management or Farm Accounts. This serious defect is now remedied. In order to avoid certain difficulties, the syllabi on Farm Management and Farm Accounts have been incorporated into the Agricultural Economics syllabus. Three more periods a week will be given to Agricultural Economics to complete this lengthy syllabus: but this will enable ALL students getting a B. Sc. degree in agriculture to have Farm Management and Farm Accounts. News has just come that this recommendation has been accepted by the Allahabad University and that this will come into force from July 1948.

Short Course—At the request of students specializing in Animal Husbandry and Dairying and in Pomology a short course in Farm Management was given for the first time by the department during the Dasehra holidays. About twenty-five students took this course.

Research—With Mr. Saxena's help the department was able to undertake a few of the projects mentioned in the last year's report. We have prepared charts showing the labour requirement by 10-day periods for certain important crops grown on the Institute farm. This has already been sent to the Allahabad Farmer. There is a wealth of material in the farm office which will be of great use to us; we hope to make good use of it now that we have secured a calculating machine and an office!

REPORT OF THE AGRONOMY DEPARTMENT, 1946-47.

E. F. VESTAL, Ph. D.

Staff:

Mr. B. M. Pugh took a year of sabbatical leave and E. F. Vestal officiated as head of the department in his absence, taking over Mr. Pugh's teaching and the direction of research. Mr. G. D. Singh continued in the department as part time teacher and part time assistant to the Farm Manager, Mr. N. R. Day joined the staff at the beginning of the year and has carried a good share of the teaching load. Mr. M. Siddiqui has been in charge of the farm vegetable Section.

Research and Experimentation: (G. D. SINGH.)

The Agronomy Department continued the programme of reseach and experimentation reported in the 1945-46 Annual Report, the main objectives of the past year being the selection or developing of varieties of the crops most suitable for this locality.

Sugarcane:—In February 1946, two varieties of cane, Co. 453 and Co. 393, were selected from the Coimbatore varieties previously carried in the test experiments (See Allahabad Farmer, Vol. XX, July, 1946). These were selected in order of merit and grown in a randomized block experiment which was varietal as well as agronomic.

The layout consisted of four blocks, each containing six plots which were arranged in sets of threes. The plot size was 15′×116′ or 18′×116′, the variation being due to a difference in row number, the middle plot of each set of three containing one less row than the two marginal plots. At harvest time each experimental plot size was limited to the minimum area of 15′×116′.

The canes used for setts were divided into three portions, top, middle and bottom. Setts from these portions were used for planting so that the plots for each variety were planted with setts taken from top, middle and bottom, hence the arrangement into sets of threes referred to above. The data for yield of cane, juice and gur are given in the following tables.

Total yield (in maunds) of the top, middle and bottom setts of two varieties of sugarcane grown at Allahabad, India.

Co 453			Co 393		
Top	Bottom	Middle	Top	Middle	Bottom
85·3	82·6	77·4	77·2	77·2	59·2

Significant difference : 18·7

Total yield (in maunds) of juice of the top, middle and bottom setts of two varieties of sugarcane grown at Allahabad.

Co. 453			Co. 393		
Top	Bottom	Middle	Top	Middle	Bottom
40·4	39·3	38·5	40·1	38·8	30·6

Significant difference : 10·85

Total yield (in maunds) of gur of the top, middle and bottom setts of two varieties of sugarcane grown at Allahabad.

Co. 453			Co. 393		
Top	Bottom	Middle	Top	Middle	Bottom
8·02	7·9	6·7	8·5	8·02	7·9

Significant difference : 13·5

It can be readily seen that there was no significant difference between the top, middle or bottom portion when used as setts and grown in a randomized layout on the Institute farm. These data together with observations on the farm indicate that Co. 393 is somewhat superior to Co. 453 in a yield of gur and also requires less power for crushing.

Paddy :—A randomized block experiment was laid out in which seven varieties of rice were tested, namely, Basmati, Jarwan, Lijura, Type 1, No. 17, Bansi and Jhalore. Of these No. 17, Jhalore, Jarwan and Lijura were selected for 1946-47 experiment. Bansi and Basmati were dropped out because of their poor performance; Type 1 and Ramkajra were also not included in the experiment because of earliness and poor performance. Ramkajra and Type 1 were grown separately in duplicate plots in the hope of putting these two varieties again in a randomized block experiment with some other

early paddy varieties in the future. The plot size was 10′×50′ and there were six replications. The ultimate size, after removing the border rows from each plot and two feet from each end, was 8′×46′. The total grain yield of paddy (grain) in seers was as follows :—

Jhalore	Jarwan	No. 17	Lijura	Sig. difference
57·5	56·0	52·5	49·0	7·4

Yield of Bhusa in seers of four ovarieties of rice grown in a randomized layout at Allahabad.

Jarwan	Jhalore	No. 17	Lijura	Sig. difference :
263·0	230·5	144·5	125·5	43·2

This year again it appears that a local variety is better than the improved variety No. 17, although not significantly superior to No. 17. Earliness is a quality which may be considered very desirable for paddy if the field in which paddy is grown is going to have a rabi crop. Although No. 17 was third in the yield of grain it might be considered suitable for Allahabad because of its earliness.

Seed Treatment :

Juar seed treatment for fodder :—A juar seed treatment trial was put in a randomized block layout. The treatments were Arason, Spergon and these were compared with the check. There were eight replications and the experimental plot size was 14′×40′. The following result was obtained in the yield of fodder.

Yield of fodder in maunds.

Spergon	Check	Arason	Sig. difference :
48·9	47·7	45·9	5·79

Statistically there is no significant difference in the treatments.

Wheat seed treatment :—Another seed treatment trial on wheat was put in an eight replicated randomized blocks layout in which I.P. 4 was the wheat used. The treatments were Spergon, Barbac-C, Arason and check. The plot size was 6′×24′. The ultimate plot size after removing border rows and one foot from each end was 4′×22′. The following results were obtained :—

Yield in seers of grain of I. P. 4 wheat treated with chemical seed treatments and sown in a randomized layout at Allahabad.

Control	Barbac-C	Spergon	Arason	Sig. difference :
	14·0		12·5	3·16

Yield (in seers) of bhusa of I. P. 4 wheat treated with chemical seed treatment and sown in a randomized layout at Allahabad.

Spergon	Arason	Barbac-C	Control	Sig. difference :
40·5	39·5	34·5	34·5	8·42

The statistical analysis showed that there was no significant difference in the yield of grain and bhusa due to the treatments.

Maize seed treatment for fodder :—In 1946-47 a maize seed treatment trial was put in a randomized block layout. The treatments were Arason, Barbac-C, Spergon and these were compared with the check plots. Equal amounts of seed were treated with each of these chemicals and planted in a six replicated layout. The plot size was 15′×60′, and the ultimate plot size, after removing border rows from each plot and two feet from each end, was 10′×56′. The total maize cobs yield of each treatments in seers were as follows :—

Yield in seers of ears of maize treated with three chemical seed treatment compounds and planted in a randomized layout at Allahabad.

Barbac-C	Arason	Spergon	Check	Sig. difference :
136·5	127·5	124·0	119 0	25·3

Yield in seers of fodder of maize treated with three chemical seed treatment compounds and planted in a randomized layout at Allahabad

Barbac-C	Arason	Spergon	Check	Sig. difference :
218·5	218·5	216·5	204·5	42·3

The statistical analysis showed that there was no significant difference between the treatments, although the data showed that treated seeds were better than the check in yields of ears and fodder. In America Barbac-C is specially recommended for treating maize seed before sowing.

Potato seed treatment :—In continuation of the Potato seed treatment trials reported in the Botany Section of the Report of the Biology Department 1945-46 (Allahabad Farmer, Vol. XX July, 1946) early and late potatoes were treated with spergon at the rate of 50 gms. of the chemical to a maund and were planted in alternate rows with untreated seed. Yield data are included in the following table :

Yield (in seers of tubers) of early potatoes treated with Spergon and planted in alternate rows at Allahabad.

Row No.	Treated	Untreated
1	..	158·5
2	146	..
3	..	158·5
4	153	..
5	..	152·0
6	173·5	..
7	..	162·5
8	174·5	..
9	..	174·0
10	174·0	..
11	..	156 5
12	183·5	..
13	..	175·5
14	173·5	..
15	..	154·0
16	178·5	..
17	..	156·0
18	176·5	..
19	..	164·5
20	172.0	..
21	..	160·0
22	179·0	..
23	..	157·0
24	179·5	..
Total ..	2063·5	1929·0

The treated potatoes gave a 7 per cent. increase in yield over the untreated ones. When the data is statically analyzed by student's method, the value of it for the early potatoes is found to be 2·91 and for the late potatoes 2·98. These figures are significant in favour of the treated seed.

Yield (in seers of tubers) of the hill potatoes (late) treated with Spergon and planted in alternate rows at Allahabad.

Row No.	Treated	Untreated
1	106·0	..
2	..	101·5
3	125·0	..
4	..	99·5
5	124·5	..
6	..	117·0
7	128·7	..
8	..	128·5
9	130·0	..
10	..	122·0
11	115·0	..
12	..	84·0
13	118·0	..
14	..	110·0
Total ..	847·2	762·5

The treated potatoes yielded 10 per cent. more than the untreated. From observations and data secured in the field it is evident that Spergon controls the root rotting organisms of the soil. Germination and stand were more uniform as determined by seedling counts during the growing period.

Juar experiments (*Sorghum vulgare*):

Juar seed varietal experiments:—Five varieties of juar were planted in a randomized block layout. These were Do-dana yellow, Do-dana white, Malwa white, 5 Tall and Type 9. 2054 was dropped because it was early maturing and readily damaged by birds (See Allahabad Farmer Vol. XX—July 1946). This was replaced by Type 9. The plot size was 10′×90′ and there were six replications. The ultimate plot size, after removing the non-experimental portions, was 6′×86′. The total yield of grain in seers, of all the varieties were as follows:—

6 Tall and Type 9	Dodana yellow	Malwa white	Do dana white	Sig. diff.
53·0	50·0	49·5	45·5	8·06

There was no significant difference in the yields of varieties last year or this year, when the data were analysed statistically. This year's grain yield of 5 Tall and Type 9, the

government recommended varieties, have shown that these may prove promising varieties for the Allahabad area.

Juar spacing trial:—This year again a juar spacing trial was put in a randomized block layout. The plot size was 20′×72′ and there were six replications. Type 9 was sown in three spacings, namely, 2′, 2½′ and broad-casted. The yield of fodder of the three spacings, in seers, were as follows:—

Broad-casted	2 feet	2½ feet	Sig. difference:
80.1	63.2	57.0	8-18

The statistical analysis showed that broad-casted was definitely superior than the 2 feet and 2½ feet spacings when juar is grown for fodder.

Juar fodder varietal trial:—In 1946-47 six varieties of juar were planted in a randomized block layout. There were six replications and the size of the plots was 12′×90′. After removing the non-experimental portions the individual plot size was 8′×88′. The total yield of fodder, in maunds, of the six varieties were as noted below:—

Malwa white.	Type 9.	Do-dana white.	Do-dana yellow.	2054.	5 Tall.	Sig. diff:
28·7	27·5	26 9	26·5	26·2	23·0	3·1

The statistical analysis showed that Malwa white, Type 9, Do-dana white, Do-dana yellow and 2054 are statistically better than 5 Tall in fodder yield.

Wheat Varietal Trial:

The 1946-47 wheat trials included the varieties, X-1, X-7, X-9, I. P. 52, I. P. 111, and C. 13. These were selections from the ten varieties grown in 1945-46 (See Allahabad Farmer, Vol. XX—July, 1946). The other four varieties, X-2, X-5, X-10 and X-11 were dropped because of poor performance. The plot size in the 1946-47 layout was 8′×66′ after removal of the non-experimental portion. The 1946-47 yield data are given in the following tables:

Weight of grain in seers of six varieties of wheat grown in randomized layout at Allahabad.

X-7	C-13	X-1	I. P. 52	X-9	I. P. 111	Significance difference:
82·5	76·0	75·0	69·5	66·0	60·0	10·54

Weight of bhusa in seers of six varieties of wheat grown in a randomized layout at Allahabad.

X-7	X-1	C-13	I. P. 52	X-9	I. P. 111	Sig. difference:
180·5	172·0	160·0	146·5	146·0	128	17·62

It will be recalled that X-1, X-7 and X-9 are selections made by Dr. Sri Ranjan, Botany Department, Uuiversity of Allahabad, who irradiated seeds of I. P. 52 with X-rays.

The Farm (S. R. Misra.)

The total rainfall in the year (31·25 inches) was about the same as last year, that is, about 8 inches lower than the normal for Allahabad. However, the year as a whole was more favourable agriculturally than last year. The monsoon started from June 18th, the normal time. Seeding operations started according to the schedule. The rainfall through August was fairly well spread and the total rainfall also during the rainy season was about normal. The Jamuna river rose thrice during August, the highest level reaching 157 ft. There was very considerable loss of the standing crops, especially the fodders, yet the net result of the rainy season crops was much better than last year.

Although much lower than the normal, there was some rain every month from September to March. About the middle of December there were some frosts but far less than the record frequency of last year. On the 12th of March there were hailstorms three times. The sewage supply for irrigation was not enough. As such, the winter crops did not fare as well as the rainy season ones, yet they were a little better on the whole than in 1945-46. While the germination of *kharif* crops was good all round, there was general complaint in the germination of wheat. The months of April and May were rainless and so helpful for the harvesting and threshing operations. Also it was indirectly helpful to summer ploughing which, of course, benefitted the next year's (1947-48) crops.

A table giving the results of crops on the Institute Farm for the year 1946-47.

Crops	Area in acres	Total yield	Total cost	Total income	Surplus or deficit.
		Mds.	Rs.	Rs.	Rs.
Early bajra fodder ...	24·4	8,080	4,541	4,087	−454
Juar and arhar ...	107·0	280	12,573	25,638	+13,065
Juar fodder, etc. ...		30,315	...	...	...
Bajra	...	68	990	1,337	+347
Bajra fodder	10·3	1,054	...	...	...
Guara	2·70	4	176	394	+218
Guara fodder	...	495	...	...	...
Maize	10·40	(*a*)	2,010	2,439	+429
Maize fodder	...	1,403	...	...	...
Sann-hemp	22 00	65	...	...	...
Sann-hemp straw, etc ...	...	158	1,478	888	−590
Cowpeas	37 35	7	3,544	4,017	+473
Cowpea fodder	...	3,911	...	...	...
Napier grass	23·00	33,884	15,230	19,408	+4,178
Guinea grass	2·40	1,803	653	930	+277
Grasses	...	16,863	5,009	7,423	+2,414
Wheat	127·80	813	15,398	15,931	+533
Wheat straw	...	1,618	...	...	...
Barley and gram ...	49 13	323	3,311	5,027	+1,716
Barley and gram straw ...	...	443	...	...	...
Early potatoes	5 64	1,013	2,990	5,653	+2,663
Hill potatoes	9 85	692	3,925	3,327	−598
Vegetables	17·60	1,292(*b*)	5,996	5,730	−266
Berseem	4·45	954	1,046	1,281	+235
Lucerne	6·70	1,169	1,772	1,061	−711
Miscellaneous fodders (*c*) ...	12·10	4,738	3,073	5,324	+2,251
Miscellaneous crops (*d*) ...	4·50	695	1,094	942	−152
Sugarcane	0·60	11	89	6	−83
Rain Fed Farm	40·00	...	3,658	1,262	−2,396
Total ...	...	...	88,556	1,12,105	23,549

(*a*) We had 67,162 green maize ears sold and 17 maunds and 10 seers of grain reserved for seed.

(*b*) This quantity excludes cabbages, cauliflowers, knolkhol, lettuce, raddish and turnips which were sold by number, but their cost and income are included in the figures.

(*c*) Miscellaneous Fodders include cowpeas, sunflower, oats, raddish and mustard fodders and some maize and juar.

(*d*) Miscellaneous Crops include sweet potatoes, ground nuts, lima beans and soyabeans.

The results this year show a handsome surplus where there was none last year. All the fodder crops show good surplus except the yearly bajra account under which some other crops like sawan and maize were sown as a measure of co-operation with the Government Grow-More-Food Scheme. Special arrangement for tubewell irrigation was made for it but all at a loss to us. Also the better results on fodders are due to the fact that the year under report had the full effect of increased prices.

Another crop to attract attention is potatoes. The increased profit is primarily due to the good seed. In the last report it was mentioned how the Government control of seed potatoes brought a situation which resulted in failure of our potato crop.

This year for the first time in the history of the Institute about fifty acres of wheat was harvested and threshed by a combined harvester-thresher machine. The data regarding this work will be given later after more trials. However, the lower out-turn of straw is quite apparent.

The Lucerne account in the above is for the period from October, 1945 to September, 1946.

The sugarcane crop failed completely.

The position regarding labour was as below :—

		Total man-days.	Total wages cost.
Direct employment	...	41,474½	37,000
Indirect employment	...	3,143	3,382
Total	..	44,617	40,382

The second line man-days figure is an estimate of man-days on some operations done by piece-work as well as the workshop labour used on the combine. Some work was done by outside grass-cuts, the man-days of which have not been estimated. Even then the man-days total this year falls much short of the 1945-46 total. This shows growing scarcity of farm labour. However, the rate of wages has risen to approximately 150 per cent. of the wages cost in 1945-46. The cost of materials, feeds, etc,, has risen too considerably. This is also quite apparent from the total cost figure in the above table as compared with that of 1945-46.

The cropping scheme followed on the farm is also given below :—

The whole farm area, for the purpose of this scheme has been divided into four sections. Each section covers several fields which are of similar physical nature but may not be adjoining each other.

Section A—Unirrigated good land :

Rotations :—3 course—2 years.

Year	Season	I 37 acres	II 16 acres.	III 16 acres.
1945-46 ...	Summer	... Clean weeds	Plough and manure.	Plough.
	Kharif	... Under water	Juar fooder..	Cowpea fodder.
	Rabi	... Wheat ..	Berra or Gram	Wheat.
1946-47 ...		I	III	II

NOTE—The above rotation will change if and when tube well is available to irrigate this area.

Section B—Unirrigated poor land :

Rotation :—4 course—3 years.

Year	Season	I 35 acres.	II 35 acres.	III 35 acres.	IV 10 acres.
1945-46	Summer ...	Plough ...	Plough ...	Plough ...	May be ploughed.
	Kharif ...	Seed Juar with Arhar. 2 : 1	10 ac. green manure. 25 ac. seed Sanai.	Fodder ...	Juar Water. ...
	Rabi ...	Arhar	25 ac. seed Sanai 10 ac wheat	Berra and Gram.	Barley or Wheat.
1946-47 ...		II	III	I	IV
1947-48 ...		III	I	II	IV

NOTE—The most important crops in this section are seed Juar and seed Sanai in order to meet the Government agreement and our seed requirement.

Section C—Sewage irrigated area :

Rotation :—5 course—4 years :

Year	Season	I 12 ac.	II 12½ac.	III 12 ac.	IV 12 ac.	V 12 ac.
1945-46 ..	Summer ..	Napier	Plough manure	Pumpkin etc. Early bajra: 6 acres.	Plough	Plough.
	Kharif ..	Napier	Early maize	Early fodder.	Juar fodder	Cowpeas
	Rabi ..	Napier	Potatoes ..	Oats may be with peas.	Wheat	Wheat
1946-47 ..		I	III	IV	V	II
1947 48 ..		I	IV	V	II	III
1948-49 ..		I	V	II	III	IV

NOTE.—In this rotation primary consideration is the present sullage supply with which we can hardly control more than 20 acres after rainy season.

The above rotation might need a little adjustment if either the sullage supply increases or the contemplated tube wells are provided. The main effect of this provision will be toward enhanced production of the crops mentioned above, many of which until then will go with insufficient or without irrigation.

Section D—Indalpur Tubewell irrigated area :

Rotation :—6 course—4 years.

Year	Season ..	I 10 ac.	II 20 ac.	III 20 ac.	IV 20 ac.	V 20 ac.	VI 20 ac.
1945-46	Summer	Napier	Plough	Plough	Plough & manure.	Plough	Lucerne 5 ac. Cane 1 ac. Partly manure and plow 14 acres.
	Kharif ..	„	Green manure.	Juar fodder.	Juar fodder.	Cowpeas	Fallow 6 ac. Cane and veg. 4 ac.
	Rabi ..	„	Berseem 10. Oats 10	Fallow	Winter Juar or Maize & Cowpeas.	Wheat	Lucerne 5 ac. Miscl. 5 ac Cane and veg. 10 ac Lucerne 5 ac, Miscl. 5 ac.
1946-47		I	III	IV	V	II	VI
1947-48		I	IV	V	II	III	VI
1948 49		I	V	II	III	IV	VI

NOTE I.—Primary consideration in this rotation is the tube-well water supply which we find after careful thought and calculation, cannot control effectively more than 40 acres after the rainy reason.

II.—Column VI: Due to the nature of the crops mentioned therein it could not be fitted into the rest of the rotation. Also the crops occurring therein require such a built-up soil, the like of which is not yet available to the extent to permit their being rotated.

III.—"Miscellaneous" means miscellaneous crops including new and explorative crops such as sunflower, sweet potatoes, groundnuts and the like.

V.—Vegetables 10 acres. Three acres of this will be under potatoes which with the area in Section C will be 15 acres. The rest of 7 acres will be 2 acres cabbage, one acre tomatoes, and others. A more careful list has to be drawn up. The total vegetable area has been cut down to half. Those of the less profitable or losing ones are still retained because (1) if the quantity is not enough to serve the market, it will serve the local group. (2) due to reduction in area and better arrangements started lately, greater care and practical study of vegetables will be possible which are expected to lead to improvements and success where there were failure before.

REPORT OF THE DEPARTMENT OF HORTICULTURE, 1946-47.

By W. B. Hayes, M.Sc., Theodore Dean, B.Sc. (Agr.) and Mohammad Sharif, B. Sc. (Agr.)

The mango crop of 1947 was a complete failure, not only at the Institute but throughout the district and in most parts of the United Provinces. This may be due in part to the weather in the flowering period. It remained cool unusually late, and then very quickly became hot. This also shortened the flowering period of the citrus fruits, resulting in a poor set of fruit.

Climatic factors may also have something to do with the failure to get a satisfactory crop of figs in the spring of 1947, using the methods which had given promise in the previous year. Suitable fruits of the wild fig, which furnish both pollen and the insect which brings about pollination, seemed not to be available when they were needed.

Several new varieties have been introduced into the variety orchard, including a sweet lemon kindly sent by the Secretary of the Board of Agriculture of Nepal, a graduate of the Institute. This is distinct from the sweet lime which is commonly grown, and will be watched with interest. Seedlings raised from citrus fruits brought from Sikkim in 1945 have also been planted in the orchard. Two varieties of

loquat, Safeda and Golden Yellow, have been added. Some other interesting plants are in the nursery, but at the time of writing the nursery is under water in the worst flood of the Jumna in 32 years, and the plants may all be lost.

The serious problem of plant diseases still faces the fruit grower of the United Provinces. At the beginning of the papaya season a plot of three acres was probably the best the Institute had ever had, and was auctioned to a dealer for Rs. 11,350. Before the season was finished a number of trees had died, and because of this and of marketing difficulties during riots, the price was reduced by Rs. 1,000. By the end of the summer only about 300 trees were left which gave promise of living through another season, and of these about one-third were male (functionally staminate). Previously only about 15% were male. The greater resistance of the male plants may be because of greater vegetative vigour than the females which bear heavy crops. In this orchard new seedlings have been planted in some spots which have been treated with soil fumigants, under the direction of Dr. Vestal, and in some untreated spots. In a new orchard the experimental use of large amounts of manure as a means of reducing the numbers of pathogenic fungi in the soil has been tried.

The wilt disease of the guava, which has been attributed to a species of *Cephalospora*, has not been entirely eliminated although the loss in the Institute was less than in the previous year. In some orchards in the area, however, the loss was the most severe of any year. Recent work at the University of Lucknow indicates that the same or a very similar disease is caused by injury to the roots by a species of *Fusarium*.

Wither-tip of citrus trees was again rather severe, after a year in which there was little of it, and may be partly responsible for the poor set of fruit.

Giant mealy bugs were again a serious pest of a number of trees in the spring of 1947. Tobacco decoction, if strong, killed the bugs it struck, but frequent spraying is necessary as more bugs keep crawling up the trees. Hand picking is tedious and effective only on low trees. Banding the trees with 'namhar,' as recommended by Rahman and Latif (Bul. Ent. Res. 35 : 197-209, 1944) proved an effective control, but has killed patches of bark on some trees. It contains ½ lb. commercial concentrated sulphuric acid, 1 lb. of castor oil, mixed

and stirred vigorously and kept for 14 days and added to a mixture of 2 lbs. of axle grease and 2½ lbs. of rosin.

Further tests of the treatment of *babul* (*Acacia arabica*) seed with concentrated sulphuric acid gave the following results :

Period of soaking	Time of germination	Percentage of germination
2½ hours	7 days	30·4
40 minutes	9 „	39·1
25 „	10 „	38·1
Not treated (control) ..	17 „	13 0

The Department has secured a permit for the manufacture of fruit products, but the shortage of sugar has limited operations so that the demand could not be met.

REPORT OF THE DEPARTMENT OF ANIMAL HUSBANDRY AND DAIRYING, 1946-1947.

JAMES N. WARNER, M. Sc.

Personnel.

Dr. T. W. Millen	... Professor of Animal Husbandry and Dairying ; Department Head (on leave.)
Mr. J. N. Warner	... Associate Professor of Dairying ; Officiating Department Head from 16th February.
Dr. A. W. McClurkin	... Associate Professor of Animal Husbandry.
Mr. T. V. Rama Iyer	... Lecturer in Dairying ; Acting Dairy Manager ; Acting Department Head from January to 15th February.
Mr. I. N. Mathur	... Lecturer in Animal Husbandry.
Mr. S. S. Bhatia	... General Supervisor in Animal Husbandry ; Acting Department Head from April to December.
Mr. P. K. Bhargava	... Lecturer in Animal Husbandry.
Mr. P. C. Thomas	... Assistant Lecturer.
Mr. P. Roy	... Assistant Lecturer.
Mr. R. P. Arora	... Assistant Lecturer.
Mr. K. Das Gupta	... Dairy Supervisor.

Dr. T. W. Millen left in July for America where he is studying for the Ph.D. degree in Animal Physiology at the University of Illinois, Mr. J. N. Warner returned from America

on 29th January ; on 15 February he became officiating Department Head. Mr. S. S. Bhatia left the department at the end of December to become Dairy Development Officer in the Animal Husbandry Department of the United Provinces Government ; Mr. P. K. Bhargava left in December to become Assistant Dairy Development Officer in Delhi Province ; Mr. P. C. Thomas resigned in September to become Manager of the Bengal and Bihar Farm, Hazaribagh ; Mr. P. Roy started his work in October, but resigned in February to farm for himself at Hazaribagh. Mr. R. P. Arora was appointed in April 1946 to assist in the department ; he was assigned some teaching from January, 1947.

Dr. A. W. McClurkin arrived in India at the same time Mr. Warner returned. He holds the Doctor of Veterinary Medicine degree frem Kansas State College. Following his training there he assisted in a private veterinary practice for several months, then entered the U. S. Army where he spent over three years in the veterinary corps ; his service was in U. S., Canada, and Alaska. He joins our staff to take over the veterinary work in the department and teach veterinary and animal breeding courses.

Milk and Milk Products (T. V. RAMA IYER.)

The amount of milk and milk products sold in 1946-47 are given monthwise in Table 1.

TABLE I.

Sale of milk and milk products from April 1946 to March, 1947.

(Figures in pounds and ounces.)

Month	Milk	Butter	Dahi	Cream cheese.	Cream	Ghee	Ice Cream	Cheddar cheese	Daily average of milk
April ..	32088-0	2074-12	324-0	..	60-0	39-0	761-0	200-0	1069-9
May ..	27560-0	1098-2	285-8	..	67-2	..	1357-8	213-4	889-0
June ..	27390-0	640-6	256-8	..	36-12	..	1377-4	63-2	913-0
July ..	29817-0	920-0	372-8	..	64-8	2-0	121-4	146-4	961-13
August ..	32046-8	907-2	493-8	..	64-12	..	1002-8	156-2	1033-12
September	31316-8	1263-14	746-8	..	41-0	..	1030-0	106-0	1043-14
October ..	34090-8	1450-2	537-0	..	57-14	..	892-14	247-6	1099-11
November..	32393-0	1698-8	988-8	..	91-8	4-2	339-8	421-6	1079-12
December	32191-8	1864-1	431-8	..	99-14	11-0	64-14	485-1	1038-7
January ..	32985-0	698-8	233-8	..	131-0	28 0	20-0	493-14	1060-13
February	34508-0	1684-1	361-0	..	144-8	22-12	16-12	253-12	1232-7
March ..	42988-0	1895-14	802-0	..	84-10	..	48-4	48-4	1386-11
Totals ..	3 87374-0	16195-6	5832-0	..	943-8	106-14	8032-0	2834-7	1061-5
Previous year totals	317770-0	23357-4	1911-0	10 0	553-12	356-14	14442-0	3841-3	870-9

The sale of milk has been steadily increasing during the past years. An increase of 69,604 pounds was sold this year over last. Daily milk sales were highest in the month of March and lowest in June, as was the case last year. The present factors limiting further increased sale are the unsatisfactory distribution of our supply of milk at different times in relation to our demand, and the limited load which each of our delivery cycles can carry every trip.

On September 16, 1946, a Milk Bar was opened in the Civil Lines. The main reason for undertaking this extension was to see that our milk and milk products are distributed to our customers under our direct supervision, thereby eliminating many kinds of fraud. The Milk Bar is open both morning and evening ; various products, such as bulk milk, pasteurized bottled milk, fresh butter, cured cheese, cold dahi, and delicious ice cream, are supplied for sale there. The amounts of milk and milk products which were handled at the Milk Bar are shown in Table II.

TABLE II.

Sale of milk and milk products at the milk bar from September, 1946 to March, 1947.

(Figures in pounds and ounces)

Milk	Bottle milk	Butter	Chocolate mil	Dahi	Cream	Ice cream	Cheddar cheese
39793-0	1512-0	3772-0	1486-0	5653-0	94-6	2480-0	359-0

The total Milk Bar sales for the year amounted to Rs. 16,594-7-0. Our results with this project indicate that there are good prospects in maintaining such milk bars in Allahabad. We hope to make the Milk Bar a full-time distributing centre for milk and milk products in the course of time.

The sale of cream and dahi were high in comparison to previous years. This is mainly due to the increased demand at our Milk Bar. Dahi prepared under controlled scientific conditions and proper supervision is highly recommended by medical people.

The total amount of milk separated amounted to 97,939 lbs. 8 ozs. During the year the creamery utilised 1,445 lbs. cream separated from milk produced from our own herd. To meet the demand for butter we had to purchase 21,988 lbs. of cream from other sources. During the year the creamery produced 98,029 lbs. 8 ozs. of skim milk which was utilized economically for the feeding of pigs, poultry, etc. As there is constant variation in the procurement of cream, ways and means are being sought to regularize the cream supply from a definite source at a suitable rate.

Our local sale of butter is gradually coming up; by the next financial year we are confident that we will be able to compete with the sales of previous years. No export of butter was effected during this year owing to the disturbed conditions of the market.

The amount of ice cream sold during the year was less than in previous years. The difficulty in procuring sugar and other raw products made it necessary for us to restrict the orders of many of our household customers. We hope that as conditions return to normal we will be able to supply to every household customer as much of our ice cream as he wants.

The quantity of cheddar cheese sold during the year was about $\frac{1}{4}$ less than the amount sold during the year 1945-46. The demand for fluid milk was so great that we had to curtail the manufacture of this product for which a fine market is already established.

MILK STOCK

The number of milk stock increased from 184 to 195, as shown in Table III. Those showing the largest changes were the Red Sindhi and Murrah groups. The loss of milk stock due to death remains low. The number of animals sold diminished as compared to the previous year, but more intensive selection is being practiced to limit the total milk stock to a number which can be maintained conveniently by the Institute Farm. A profit of about Rs. 8,700 over the inventory valuation was realized on the 30 head sold.

TABLE III.

Milk stock.

Serial Number	Breed	Number on 1st April, 1946	Transferred from female young stock	Sold	Died	Number on 31st March, 1947
1	Red Sindhi	47	9	2	2	52
2	⅛ Jersey-Sindhi ..	10	2	4	..	8
3	¼ Jersey-Sindhi ..	30	7	5	..	32
4	⅜ Jersey-Sindhi ..	17	3	3	1	16
5	Jersey	3	..	..	1	2
6	⅛ Holstein-Sindhi ..	7	2	2	..	7
7	⅛ Brown Swiss-Sindhi ..	9	7	4	1	11
8	¼ Brown Swiss-Sindhi ..	7	3	4	..	6
9	¼ Miscellaneous-Sindhi ..	10	1	2	1	8
10	⅜ Miscellaneous-Sindhi ..	4	1	..	..	5
11	Miscellaneous	14	4	2	1	15
12	Murrah (buffalo) ..	26	9	4	.	31
	Totals ..	184	48	32	7	193
	Previous year totals ..	156	67	46	5	184

Table IV shows, among other things, the average production of those lactations completed during the year under report. Of the 130 lactations involved, 52 were those of heifers. Last year, heifers completed 40 out of 104 lactations. The production of heifers is not taken into account in calculating the over-all daily average, for a heifer has no dry period preceding her first lactation. This production is included, however, in calculating the daily milking averages.

The total production of the herd during the year was 5,54,903·5 lbs. or an average of 1520.3 lbs. a day. As reported last year, we consider a production of 1,500 lbs. a day is adequate for our experimental and educational purposes, although our commercial market would utilize more. Of this milk 4,93,066.8 lbs. were sold to the creamery; the remaining 61,836.7 lbs. were fed to calves as whole milk or separated, the skim being fed to calves and the cream being sold to the dairy.

TABLE IV

Lactations completed during the year 1946-47

Serial number	Breed	Number of Lactations completed	Average yield	Average days in milk	Average days dry preceding the lactation	Daily milking average	Over-all daily average	Number of 1st lactation heifers
1	Red Sindhi ...	28	3292 9	306·4	211·5	10·7	6·3	10
2	1/8 Jersey-Sindhi ...	8	4299·5	405·9	54·3	10·6	9·3	5
3	1/4 Ditto ...	22	4786·2	397·6	113 2	12 0	9·4	10
4	1/2 Ditto ...	15	4190·4	383·7	57·1	10·9	9·5	1
5	Jersey	1	2694 8	335·0	...	8·0	...	1
6	1/8 Holstein-Sindhi ..	5	4494·6	421·2	122·0	10·7	8·3	4
7	1/8 Brown Swiss-Sindhi	4	3163 5	395·2	310·0	8·0	4·5	3
8	1/4 Ditto ...	4	3981·4	337·0	172·5	11 8	7·8	1
9	1/4 Miscellaneous-Sindhi	7	4808·3	375·1	16·0	13·1	12·3	6
10	1/2 Ditto ...	3	3372·4	375·0	36 0	9 0	8·2	1
11	Miscellaneous ...	9	5349·3	378 6	122·2	14·1	10·7	4
12	Murrah (buffalo) ...	14	3488·7	369·8	187·1	9·4	6 3	6

The Data to Table V, compared to similar data on the four largest groups of heifers freshening the previous year, shows increases in the age of calving for the Red Sindhi and Murrah and decreases for the 1/4 Jersey-Sindhi and 1/8 Brown Swiss-Sindhi groups, although the changes are small. For the most part, the age at first calving for the other groups increased during the year under report compared to the previous year.

TABLE V

The average age, weight, and height at withers at first calving of 48 heifers transferred to milk stock during the year 1946-47.

Serial number	Breed	Number of animals	Average age in years	Average weight in lbs.	Height at withers in inches
1	Red Sindhi	9	3·92	667·2	44·77
2	1/8 Jersey-Sindhi	3	3·45	632·3	45·30
3	1/4 Ditto	7	3·18	700·4	45·55
4	1/2 Ditto	2	2·80	537·5	41·75
5	1/8 Holstein-Sindhi ...	2	3·45	710·0	44·45
6	1/8 Brown Swiss-Sindhi ...	7	3·65	709·3	45·25
7	1/4 Ditto ...	3	3·73	733·3	44·80
8	1/16 Miscellaneous-Sindhi ...	4	3·44	660·3	43·77
9	1/4 Ditto ...	1	3·21	627·0	46·80
10	1/2 Ditto ...	1	4·00	680·0	44·60
11	Murrah (buffalo)	9	4·26	1134·0	51·54

I. N. M.

Female Young Stock.

The female young stock in the dairy herd is shown breed-wise in Table VI. Of the 148 zebu and crossbred heifers, 125 contain 3/4 or more Red Sindhi ancestry. Only a small number will be graded up to the Jersey; the remainder, as in the past, are to be graded up to the Red Sindhi.

The two Red Sindhi heifers shipped in February of last year arrived at Washington D. C., U. S. A. in September, 1946. These animals, together with two young Red Sindhi bulls, made up the first group of zebus to be used for developing a heat-resistant strain of dairy cattle for the southern United States.

TABLE VI.

Female young stock.

Serial number	Breed	Number on 1st April, 1946	Born during the year	Transferred to milk stock	Sold	Died	Number on 31st March, 1947
1	Red Sindhi	30	23	9	1	9	34
2	1/8 Jersey-Sindhi ...	25	15	3	2	7	28
3	1/4 Ditto ...	13	5	7	...	2	9
4	1/2 Ditto ...	2	...	2	...	...	...
5	9/16 Ditto ...	4	...	...	1	...	3
6	5/8 Ditto ...	5	...	...	...	...	5
7	3/4 Ditto ...	6	3	...	...	4	5
8	Jersey	1	...	...	...	...	1
9	1/8 Holstein-Sindhi ...	5	...	2	...	...	3
10	1/8 Brown Swiss-Sindhi ...	14	1	7	...	3	5
11	1/4 Ditto ...	5	1	3	...	1	2
12	1/8 Guernsey-Sindhi ...	1	...	...	...	...	1
13	1/32 Miscellaneous-Sindhi	1	3	...	...	...	4
14	1/16 Ditto ...	20	8	4	1	7	16
15	1/8 Ditto ...	9	1	...	...	...	10
16	1/4 Ditto ...	2	1	1	...	...	2
17	1/2 Ditto ...	3	2	1	...	2	2
18	Miscellaneous ...	2	2	...	...	...	4
19	Murrah (buffalo) ...	25	11	9	1	3	23
	Total ...	173	76	48	6	38	157
	Previous year totals ...	189	77	67	3	23	173

Male Young Stock.

A large number of male young stock, Table VII, was sold during the year. Plans are being prepared for a new calf shed in order to reduce death losses among both male and female young stock. The shed will contain individual pens in which to keep calves for the first few weeks while they are extremely susceptible to many infections. Segregation will prevent the transmission of infection from one calf to another.

TABLE VII

Serial number	Breed	Number on 1st April, 1946	Born during the year	Sold	Died	Number on 31st March, 1947
1	Red Sindhi	18	19	15	8	14
2	1/8 Jersey-Sindhi	3	14	3	6	8
3	1/4 Ditto	1	4	1	2	2
4	1/2 Ditto	...	2	...	1	1
5	9/16 Ditto	1	...	1	...	...
6	5/8 Ditto	7	2	8	...	1
7	3/4 Ditto	6	1	6	1	...
8	Jersey	...	2	...	1	1
9	1/8 Holstein-Sindhi	1	...	..	...	1
10	1/8 Brown Swiss-Sindhi ...	1	3	2	...	2
11	1/4 Ditto ...	1	1	1	...	1
12	1/32 Miscellaneous-Sindhi ...	...	3	2	1	...
13	1/16 Ditto ...	5	11	5	6	5
14	1/8 Ditto ...	3	...	...	...	3
15	1/4 Ditto ...	1	2	...	...	3
16	Miscellaneous	3	4	2	2	3
17	Murrah (buffalo)	6	10	...	6	10
	Totals ...	57	78	46	34	55
	Previous year totals ...	44	76	43	20	57

I. N. M.

Two young Red Sindhi bulls from our herd, a part of a shipment of four head, two heifers and two bulls, arrived in Washington, D.C, U.S.A., in September. These bulls are to be used in crossbreeding experiments for developing dairy stock for the southern states of United States.

Artificial Insemination.

One hundred and twenty-four artificial services were performed by our dairy bulls during the year. The number of natural services was 351, Table VIII. Of the services given outside cows this year 38·3 per cent. were artificial, compared with 32·6 per cent. last year. One factor which we consider important to the wide use of artificial insemination is the education of the public to the use of this method. Many people object to it on purely sentimental grounds which education alone will overcome. Serving outside cows by this method allows us to do so without exposing our bulls to infections which may result from natural services.

No short courses in the practice of artificial insemination in farm animals were given this year. Of the calves born during the year under report, 51 were by artificial insemination ; this number was made up of 2 male and 2 female buffalo, and 26 male and 21 female zebu or crossbred calves.

TABLE VIII.

Artificial insemination statistics for 1946-47.

	Institute zebus and crossbred cows	Institute buffaloes	Outside cows	Total
Direct services ..	249	20	82	351
Artificial services ..	72	1	51	124
Totals ..	321	21	133	475
Artificial services as % of total ..	22·4	4·8	38·3	26·1

Sheep.

The number of sheep in our flock, Table IX, remained substantially unchanged during this year. Six head were sold for breeding purposes. Difficulties continue to exist in obtaining a market for our wool. While we produce an improved type of wool, a wool which is medium-fine, we have a relative small quantity of it for sale at any particular time. For this reason wool mills are not anxious to purchase it; they are unable to handle such small quantities.

TABLE IX.

Sheep statistics for 1946-47.

Sex	Number on 1st April, 1946	Born	Sold	Died	Butchered	Number on 31st March, 1947
Male ..	24	21	3	18	1	23
Female ..	70	27	3	21	..	73
Totals ..	94	48	6	39	1	96
Previous year total ..	82	49	7	24	6	94

I. N M.

Goats.

Considerable difficulty continues to exist in rearing Jamna Pari kids. Death losses in kids this year were somewhat heavier than previously. Consequently, the number of Jamna Pari goats, Table X, did not increase as we hoped it might. The number of Bar-Bari goats, Table XI, increased somewhat over the previous year, although death losses here also were higher than desirable. Losses due to internal parasites are high among goats, especially the kids.

TABLE X

Jamna Pari goats statistics for 1946-47.

Sex	Number on 1st April, 1946	Purchased	Born	Sold	Butchered	Died	Number on 31st March, 1947
Male ..	11	1	12	..	..	11	13
Female ..	26	..	8	..	..	11	23
Total ..	37	1	20	..	..	22	36

I. N. M.

TABLE XI.

Bar-Bari goats statistics for 1946-47.

Sex	Number on 1st April, 1946	Purchased	Born	Sold	Butchered	Died	Number on 31st March, 1947
Male ..	4	2	7	1	..	4	8
Female ..	8	4	5	..	2	4	11
Totals ..	12	6	12	1	2	8	19

I. N. M.

Poultry.

The number of head of poultry diminished slightly more than one-third during the year, that is from 679 head to 411, Table XII. More than one-half of the reduction in the flock resulted from about 180 fewer chickens on hand at the end of the year than at the beginning. There was a reduction of 57 head of White Leghorn females; the reduction of turkeys was 23.

TABLE XII.

Poultry statistics for 1946-47.

	White Leghorn		Rhode Island Red		Silkies		Ducks		Turkeys		Geese		Guinea fowls		Capons	Chickens	Ducklings.	Totals.
	Female.	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female	Male.	Female.	Male.	Female.	Male.				
Number on 1st April, 1946.	133	40	12	8	21 Chickens.		28	42	17	17	5	2	14	6	4	288	42	679
Number on 31st March, 1947.	76	28	19	3	4	11	48	26	8	3	9	5	10	10	..	107	44	411

I. N. M.

Large numbers of birds and eggs continue to be sold for breeding and setting purposes respectively ; some birds and eggs were sold for eating purposes ; a good number of eggs were set.

Of the birds sold for breeding purposes, 55 were white Leghorns, 57 were ducks and 15 were turkeys. Others sold for breeding brought the total to 144. The flock layed 8,562 eggs of which 1,393 were sold for hatching ; the largest number were those of the white Leghorns, followed by ducks and Rhode Island Reds, in that order. Death losses among adult birds were 75.

Swine.

The number of pigs are shown in Table XIII. There was substantially no change in the number of pigs on hand from the beginning to the end of the year. The proportion of young pigs, however, was noticeably greater at the end of the year than earlier. The supply of fresh pork to the R. I. A. S. C. continued through June and involved 101 pigs yielding a total of 14,692 lbs. of meat. The average dressed weight of these pigs, therefore, was 145·4 lbs. While only about one-third as many pigs were butchered for this purpose as during the previous year, nearly three times as many, 39 compared to 14, were butchered for local sale. There were 36 boars sold to the U. P. Government for their Stud Boar Scheme.

TABLE XIII.

Swine statistics for 1946-47.

	Sex.	Number on 1st April, 1946.	Born.	Purchased.	Sold to U. P. Government (Boars).	Died.	Butchered.		Transferred from young stock.	Transferred to adult stock.	Number on 31st March, 1947.
							Local.	Military contract.			
Adult stock ..	Male ..	62	..	13	36	3	8	40	24	..	12
	Female .	83	..	9	..	1	31	61	43	..	42
Young stock ..	Male ..	20	99	..	..	12	..	..	..	24	83
	Female ..	24	95	..	..	22	..	..	..	43	54
	Totals ..	189	194	22	36	38	39	101	67	67	191
Previous year totals ..	..	291	339	69	52	107	14	337	268	268	189

I. N. M.

Blood Meal

Because of the disturbed condition of Allahabad during portions of the year we were unable to obtain the blood needed to enable us to make the required amount of blood meal. Neverthless we made 1',894 lbs. of dried blood during the year. We fed the quantities indicated below. Much more would have been made and fed had the supply of blood permitted.

Poultry	...	2,688 lbs.
Swine	...	4,354 lbs.
Calves	...	3,186 lbs.
Total	...	10,228 lbs.

The consumption of blood meal by the pigs was lower this year than last not only for the reason given above, but also because we raised fewer pigs to maturity. Blood meal is an economical feed and enables the efficient use of what is otherwise a waste product of the slaughter house. We continue so far as possible to raise our calves with a ration containing blood meal, in place of using milk, after the calf is 4 to 6 weeks old. This method of raising calves saves up to 1,000 to 1,200 lbs of skim milk for each calf raised.

REPORT OF THE HOME ECONOMICS DEPARTMENT, 1946-47.

GLORY C. AZARIAH, B. Sc. (HOME EC.)

The Home Economics Department had a formal opening on July 8th, 1946 at 9-00 a. m. The Principal, Dr. J. L. Goheen, opened the meeting. Mrs. J. L. Goheen, Head of the Department of Home Economics, gave an address on the ideals and aims of the Home Economics course. Mrs. Vestal

gave a history of the Home Economics Department. Since the staff and the students of this department are greatly benefitted by this formal opening, it is well to keep this up.

We are fortunate to have an efficient Head in Mrs. Goheen, who not only brought the idea of formal opening but also helped the girl students greatly by arranging an orientation course. This course included subjects such as How to be Charming, How to be Courteous, a lesson on Etiquette, a lesson on Boy-Girl relationships, and a lesson on landscape gardening.

The members of the staff of the Department were:

Mrs. Goheen, teaching Bible ;

Dr. Hayes, teaching Physiology and Hygiene ;

Mrs. Vestal, teaching Household Economics ;

Mrs. Vaugh, teaching Handicrafts ;

Miss Brooks, teaching Food Preparation, Textiles, Home Management, and Nutrition ;

Mrs. Azariah, teaching Food Preparation, Child Care, Sociology, and Sewing ;

Miss Paranjothi, teaching English and Psychology.

Miss Paranjothi had to leave in December and we were glad to have Mrs. Gideon's help for teaching English from December to April.

Miss Brooks has just left for U. S. A. Her services to the department will be long remembered. Her experience as a Home Demonstration agent in U. S. A. helped her in all fields of work in this department. She was the hostel warden, dietician, and an efficient teacher. The way she fixed the attractive invalid trays made the sick students try their best to become well and encouraged them to be happy at all times

Our girls have learnt a lot from her, especially how to entertain, how to set tables, and how to take care of the sick in the home. There isn't one student in our department who doesn't miss her. Even the Allahabad University was trying to have her as a permanent teacher. Her trips back and forth to the University on a tonga were long and tedious, but Miss Brooks was just as charming and cool after her trips as she was before. Perhaps she may be able to spend one of her sabbatical leaves with us.

We had eight students in the first year and ten students in the second year. Of the ten students who appeared for the Intermediate Examination one failed. Three students from this set were fortunate to go for their advance studies to U. S. A. Of the rest, who passed their examinations, some have good jobs in schools. Some of them have proved to be so worthy of their calling that we are always getting requests from schools to furnish more such teachers. We hope our present girls also will be just as efficient as their sisters.

The two main Institute events in which our girls took part were, the Founder's Day celebration and the Farmer's Fair.

On Founder's Day the girls had exhibits of all kinds. The one that attracted the visitors most was the foods exhibit. A balanced meal and a diet for typhoid which were attractively arranged invited numerous questions from people interested. The Farmer's Fair this year was really for the benefit of the farmers. Girls made several trips to various villages to get their attitudes, towards the Fair. During the Fair, a puppet show run by Mrs. Mosher and the girls attracted crowds. By this device, hints on child care were successfully given. A drama which was repeated four or five times a day showing the day's activities in a village home were quite well received. A model house was fully furnished, decorated and lighted by Mrs. S. Gould, who was teaching home decoration. We hope to put up even a better show this year.

Dramatics, Social Service, Social gatherings, Id, Divali, Holi, and Christmas celebrations, the Student Christian Movement, the Student Union Meetings and functions of other Associations are some of the extra-curricular activities in which our girls take part.

It was a great honor and pleasure to have Miss Sweeny during the first week of March, 1947. She spent night and day in helping us to form a new syllabus for a B. Sc. Course, which will not conflict with what the Allahabad University is giving at present. The department is investigating the possibilities of opening a third year in Home Economics provided there are suitable buildings and personnel.

Towards April plans were made to invite Miss Argenbright from U. S. A., Miss Dongre from Bombay, and Miss Simeon from Allahabad to join the department. More will be said about them in the next report.

It is gratifying to note that the people of this land have begun to see the value of this type of education and training, as indicated in the increase of applications for admission every year. During the year under review six students received financial aid. This was possible because of friends and well-wishers in the United States. We are greatly thankful to them. With the change in the political status of India, we trust the people of this land also will join hands in this worthy cause.

REPORT OF THE EXTENSION DEPARTMENT, 1946-47

A. T. Mosher, Ph. D.

The Extension Department came into being in March, 1946, but due to the deputation of the Head of the Department to other duties very little was done until October.

The major activities of the Department during the winter of 1946-47 were the organization of the short course for

students from Leonard Theological College, co-operation in the Farmers' Fair, and preliminary visits to villages around the Agricultural Institute and to Mainpuri and Bilaspur. An additional activity was the organization of two conferences of headmasters, managers, and teachers of agriculture in Christian rural schools in the U. P. and C. P. One of these was held in December, and the second was held at the time of the Farmers' Fair late in February.

This year an effort was made to turn the Farmers' Fair toward the village, and to have only the kind of exhibits which would be helpful and instructive to village people. This meant eliminating posters in the English language and some other features of the Fair which had been developed particularly for visitors from Allahabad city. Instead of these, those co-operating in the Farmers' Fair developed a number of short dramas, posters in simple Hindi, a puppet show, and models such as a model village house.

In the short course for students from Leonard Theological College three kinds of instructions were included:

(1) Elementary teaching in agriculture.

(2) Instruction in methods of introducing improvements into the village. (In this section emphasis was put on appealing to religious motives and on planning conversations with village people in such a way as to secure an affirmative response.)

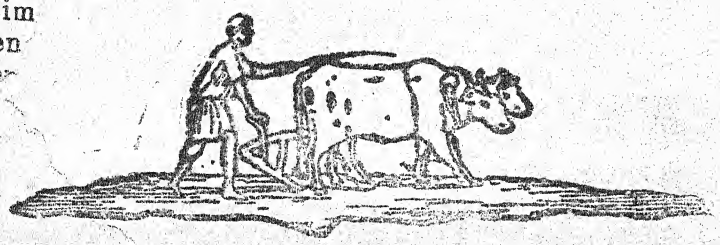
(3) Discussion of the role of improved agriculture in Christian discipleship.

By June, the Extension Department had three staff members appointed. Mr. S. S. N. Lal had been given a temporary appointment to begin extension work in the villages around the Agricultural Institute. In this area we are experimenting with handbills in the dialect of the area, hoping that

this may develop into a regular newspaper in the same language which people speak in the villages. Mr. W. R. Chester, B. Sc. (Ag.), had been appointed to the staff of the Extension Department and had been assigned as Agricultural Advisor to the North India Synodical Board, with headquarters in Mainpuri, U. P. Mr. A. N. Singh, B. Sc. (Ag.), had been appointed to the staff of the Extension Department and assigned as Agricultural Advisor to the Disciples of Christ Mission with headquarters at Nawalpur, P. O. Takhatpur, via Bilaspur, C. P.

In July, Rev. C. Murray Rogers joined the staff of the Extension Department with headquarters in Allahabad where he is also Acting Chaplain of the Agricultural Institute. In August, Miss N. R. Dongre joined the staff of the department in addition to her duties as warden of the Girls Hostel of the Agricultural Institute. Mr. Roger's major responsibility within the department is development of the conferences and short courses conducted by the department. Miss Dongre is co-operating with the Home Economics Department in visits to nearby villages by students. In addition, she is getting acquainted with the village women of a few villages near the Institute, preparatory to making plans for extension work to help them.

THE
ALLAHABAD FARMER



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"CULTIVATION AND STORAGE OF POTATOES IN BIHAR WITH SPECIAL REFERENCE TO THE DISEASES PREVALENT IN STORES, AND THE FIELDS."

BY N. R. DEY, B. (AG.), ASSOC., I. A. R. I. DEPARTMENT OF AGRONOMY, A. A. I.

INTRODUCTION.—This article is the result of the work done in the scheme on Insect and Diseases of stored potatoes in Bihar, carried out at Sabour, (Dist. Bhagalpur) from March 1943 to April 1946.

The above scheme was a war scheme financed and controlled partly by the I. C. A. R., and partly by the Department of Agriculture, Bihar.

The object being to devise suitable control measures, that could be economically and successfully adopted by the cultivators, against Insect pests, and Diseases of potatoes in storage.

The work of the scheme was divided into two parts; (I) Entomological part, sanctioned in the first instance for a period of five years, (II) Mycological part, sanctioned for three years. In this article only the work of the Mycological part of the scheme is dealt with.

The Technical programme for this aspect of scheme consisted of (*a*) the observance of the different types of rots, and, other diseases in storage, their period of activity, and extent of damage in relation to the existant methods of storage, (*b*) Pretreatment of tubers before storage, and evolution of an improved method of storage.

The second part of the programme could not be satisfac ly concluded, on account of the relatively short period, and subsequent abrupt cessation of the scheme, therefore, part of the work is duly omitted.

Data were collected from the different, important p growing and storing localities, by touring and examining tubers in storage, and the crop in the field, from time to e, for the duration of the scheme. Observations were also take of the varieties grown, and stored for seed and table use on different organisms found attacking the varieties in stores and the field; the percentage of incidence in different varieties, methods of storage and consequent precautions taken to reduce loss in storage, effect of environment factors on the incidence of diseases in storage and in the fields, in the following districts and the important areas mentioned therein :—

District.	Area.
Bhagalpur ..	Colgong, Sultangunge,
Patna ..	Gulzarbagh, Mussalahpur, City area, Phulwari Sharif, Bihar Sharif (within a radius of forty miles),
Gaya ..	Bodh Gaya, Manpur, Khanjahapur, Soni, Nawadeh,
Shahabad ..	Arrah, Tilothu,
Saran ..	Chapra, Sonepur, Siwan,
Champaran ..	Bettiah, Motihari, Raxaul,
Muzzaffarpur ..	Muzzaffarpur (30 miles radius), Lalgunj, Hajipur,
Darbhanga ..	Pusa, Mahmudha, Darbhanga, (Usauthu), Sauli,
Ranchi ..	Ormanjhi, Nagri, Lohardagga,
Hazaribagh ..	Daru, Ramgarh, Chitarpur, Lari, Gola,
Palamau ..	Khamdih, Tori, Nawa,
Singhbhum ..	Chaibassa, Kolhan Estate,

POTATOES PRODUCTION IN BIHAR.

In Bihar potatoes are grown in the plains during the months of mid-September to March. The total area being 95,000 acres or 25% of the acreage in India. Approximately 10,000,000 maunds. or 20% of the total amount is produced. Seed tubers from Bihar are exported to the Punjab, Bengal and U. P., as the province has comparatively a large supply of surplus seed tubers. By the middle of September 75-90% of the total amount of tubers exported is sold off to the "beoparis".

The districts of Patna, Gaya, Hazaribagh and Darbhanga happen to be the main areas of cultivation, large amounts being distributed within and outside the province, from Bihar Sharif, Patna and Gaya. Large quantities of potatoes are grown in the districts of Monghyr, Shahabad, Saran and Purnea, but the amount of tubers exported is limited.

VARIETIES GROWN.—In Bihar the varieties in demand for seed are the Phulwa, Surkha, and Satha.

Phulwa :—A thin skinned variety, maturing in 90 to 150 days, widely grown in the U. P., Punjab, Bengal and extensively in Patna district. Sown in last week of September to mid-October. The variety flowers freely, is adaptable, a high yielder, and during storage, tubers keep well. Tubers are white small, round, with a smooth surface, medium deep eyes, and slightly developed eye brows.

Satha :—A thin skinned variety, easily attacked by pests, and wound organisms. Plants are small and bushy, the variety in confined in the Bihar Sharif, and Gaya areas in the province. It is sown about the middle of September to first week of October for the first crop, and in November for seed. Matures in 60—75 days, and the first crop is utilized for table use. Tubers are white, round, on cooking are good to eat.

Surkha (Red) Colgong or Cawnpuri, variety :—It is a Darjeeling variety, acclimatized in Patna area, the fresh seed is indented after every three years. The variety is more resistent to moth attack but is affected by high temperature. It is medium veriety maturing 80—100 days, and a moderate yeilder. Tubers are thick skinned rough, and pinkish in collour, with a yellowish flesh.

Kutwa (cutpiece) :—Darjeeling or Hill variety. The indented seed is cut into pieces containing eyes, for which reason it is known as Kutwa. The first year's yield is the highest. The variety is also known as the *Naika* (new) and *Domatia*, or *Dohan* and *Chaumas*.

When the Kutwa variety is grown as the early crop, and the tubers are utilized for table use, then the crop is called *Domatia*, since a second crop of the same variety can be grown, and the tubers of this crop utilized for seed.

(*a*) When the tubers are sown twice in the same field, usually on high well drained, light to medium soils, the second crop from the field is known as *Dohan*. The "dohan" tubers are smaller, posses, a good keeping quality and strong sprouts.

(*b*) The *Chaumas* crop is grown in Patna district, in the areas around the Ganges. In this case only one crop can be taken from the fields, in a year, the reason being that the crop is grown on low lying areas that are submerged by rain water till mid-October, hence the land can be prepared in Kartik (November). The tubers are bigger than the *Dohan* tubers, but are similar in quality.

Nainital :—Originated from the Magnum Bonum variety, a hill variety, being a high yielder, medium to late maturing, under local conditions it is adversely affected by high temperatures and is susceptible to moth attack, during storage. Sown in 1st to 2nd week of November, harvested in March. Tubers are large oval thin-skinned, smooth, pale, white, with prominent eyes.

Dhusra :—Local variety, extensively grown in Hazaribagh district sandy coloured, moderate yielder, resistant to disease.

METHOD OF CULTIVATION USUALLY PRACTISED.

Except where it is grown in large amounts, potatoes are generally grown in small plots or areas : These plots are prepared so as to have a good, friable tilth, by means of Pharwas or Kodalis, after being subdivided into small beds 10′×8 or 8′×6′.

Where the crop is grown on a large scale in fields having larger areas, the soil is prepared to the required tilth, by ploughing, and cross ploughing with desi, or improved ploughs, and hand weeding the fields before sowing the tubers.

The field is tilled when the soil is moist to facilitate working, and avoid puddling of soil surface. The field is prepared in such a way that the soil round the tubers remains moist after each irrigation. The field is planked once or twice, to have a level and compact surface, to facilitate good drainage, and conserve sufficient moisture.

Spacing :—Tubers are planted 4—6″ apart and 2—8″ deep, depending on the variety, soil fertility and moisture, and size of the seed tubers.

Tubers of the first crop (early variety) are planted shallow, cut tubers are planted 5—7″ apart, as the plants will be vigorous, and the tubers bigger. A closer spacing is given on irrigated, madium, to heavy soils, to reduce the size, lessen growth cracks, and avoid larger vegetative growth.

Ridges are made 18—24″ apart, the tubers being placed on the surface, and covered with the soil by means of Phawras (hoe), in larger fields, ridges are made with the ploughs, otherwise its un-economical and a slower process.

Interculture :—Normally done by manual labour by means of the khurpi, for weeding, and hoe for earthing up, and cleaning the furrows—First earthing is done when the seedlings are 5—6″ high, and the second one, after a fortnight of the first ; a third earthing may be required at the time of maturity, after tuber formation when there is a danger of

exposure of the tubers. The crop is intercultured regularly to keep it free from weeds and maintain a soil mulch to lessen the surface evaporation.

IRRIGATION.—The crop is largely grown on irrigated land, and the yield is greater under irrigated conditions. Irrigation is especially necessary when the crop is grown on high lands, in the case of a chaumas crop, the field remains sufficiently moist for 6—8 weeks, hence a lesser number of irrigat are required. Normally the source of irrigation is a well, some times a Persian wheel, or a pond.

The first irrigation before sowing is heavy, after which an irrigation may be given once in ten to fourteen days, so as to keep the soil moist with due consideration of the winter rains. On the average, 8 to 14 irrigations are given from mid-October—end of March or 3—8 depending on the crop, soil region and climate. Towards maturity time irrigation is required to prevent the heavy soil from cracking.

MANURING.—Usually cowdung, or Farm yard manure is given, in an approximate dosage of 30—50 maunds. The manure being applied, by the labourers, in basket loads, and spread as far as possible, uniformly with the help of the foot, or Kodali. The manure is applied before the field is tilled, and well mixed during tillage.

Now a days those cultivators who understand the benefits derived from the use of oil cakes, and fertilizers, are utilizing these two materials for quicker production, and larger yield, willingly paying black market prices for them, and this inspite of the local belief that fertilizers, predispose tubers in storage to insect pests, and disease attack.

10—15 maunds of oil cake, preferably castor, or groundnut cake, or 5—10 maunds of castor cake, plus 1·5—2·0 (1½—2) maunds of Ammonium Sulphate is given per acre, in two or three doses, which-ever being economical and convenient. The mixture is applied before the final preparation of the field, or during sowing time, being will mixed in the soil, the second dose being given as a top dressing, at the time of first earthing.

SEED TUBER.—Medium sized tubers are healthier, in as much, that they are resistant to disease, and pest attack, yield more than the larger or the smaller tubers.

A good seed tuber should be true to the varietal type, free from disease, and pest damage, sprout at the time of planting. Good seed tubers are produced by vigorous, healthy high yielding varieties. Few cultivators, and seed merchants take

proper care in selecting the right type of seed. Generally the seed tubers used are those that are left over, at the end of the storage period, after the sale of the better product, resulting in the deterioration of the stock, and the crop.

Varietal purity cannot be maintained on account of the lack of pure seed, the sowing of mixed, and deteriorated seed tubers. It is difficult to diffrentiate the varieties, by examining the tubers only, experience, and, observation of the crop in the field enables a definite differentiation.

METHOD AND TIME OF PLANTING.—For the early variety, or first crop, whole medium sized tubers are planted, and the seed rate is normally lower than that for the late variety, or the second crop. The reason for planting whole tubers for the first crop, is that, there is a greater danger of the tubers rotting, on account of the soil borne parasitic and saprophytic diseases, present under suitable conditions of soil moisture, and temperature in the soil.

For the second crop, larger tubers are cut into pieces, each piece possess, two or more good eyes to enable quick and, regular sprouting. The cut seed is not stored for any length of time, but planted as soon as conveniently possible.

Storage in bags, or large piles, or exposure to the sun of the cut seed, accelerates infection by aerial micro-organisms rotting, or greening, and drying of the pieces. Only required quantities of healthy seed tubers should be cut for daily planting. To check drying, and contamination of the cut pieces, lime should be lightly dusted, or the pieces dipped in a dilute solution of Lime water.

The seed rate for the early variety varies from 3—9 maunds per acre, the average being 5·0 maunds per acre. The range for late varieties being 4—10 maunds, the average being 7—8 maunds.

Phulwa variety is sown in Bhado ( ), Satha in Asin ( ), Cutwa (Red) and Surkha in Aghan and Kartik in the Patna, and Bihar Sharif areas. In Gaya, Hazaribagh, and Shahabad districts, the early crop may be planted 10—15 days later. The hill varieties are sown in mid-October to end of November, in some places up to mid-December.

The time of sowing is influenced by the (i) variety sown, (ii) availability of the seed at the time, (iii) existent climatic factors.

TIME AND METHOD OF HARVEST.—For table use the crop is harvested when there is ademand, any time after the reasonable period of tuber formation, in a number of cases tubers are harvested when quite small and immature.

For seed, tubers are harvested when more or less mature. There is a local belief that the tubers for seed, if dug when the leaves are green, are more resistant to rots, in storage.

The time of harvesting is indicated by wilting, and yellowing of the foliage. The crop is dug when the soil is moist to facilitate easy digging. In heavy soils one irrigation is given before harvesting, to avoid cracking of the soil and consequent exposure of the tubers to the attacks of pests especially the potato moth, aerial micro-organisms, and sunlight, the latter causes the exposed tubers to turn green, making them bitter in taste.

The Phulwa variety is dug up in Poos (December), Cutwa in Phagun (mid-March) while Satha is dug up in Kartik. Digging of the crop starts about middle of November, finishing by the first week of December, in the case of the early varieties. The late crops of Satha, and Cutwa are dug up in Phagun (mid-March).

Usually the early variety is bought off by the prospective buyer, who has the crop dug, and transported in his presence to the Arhat or the stall.

Tubers are dug up, by means of Pharwas (hoes) or Khurpis, or some times by the desi plough, in each case the tubers are collected by the labourers, or the cultivators.

During digging tubers can be damaged by careless digging and handling, causing injuries, and cuts. The percentage of damage is dependent on the method of digging, distance of planting (*e.g.* row to row and plant to plant), and the nature of soil. Usually the percentage of damage varies from 15—45%, a smaller percentage of damage is caused if the crop is dug by means of adjustable implements like hoes, and khurpis. Tubers are lifted easily in lighter soils. Damaged tubers are easily susceptible to pest attack, and disease infection in storage, during prevalent conditions suitable for pest, and disease development.

YIELD.

The yield of the early varieties ranges from 50—80 maunds, while the yield for the late varieties (2nd crop) varies from 100 to 250 maunds per acre, under suitable conditions of moisture, and fertility, or wherever the crop is suitably manured, and irrigated.

STORAGE.—The aim in storage is to protect the tubers from insect disease damage, and from unfavourable environmental conditions, preserving them in a suitable state for seed, and, table use, without affecting the sale value.

Methods of storage are essentially the same all over the province, but differ locally in certain respects.

For table use the tubers are stored for a short period varying from 6—8 weeks, there is not much loss in these tubers. Normally for seed, the tubers are stored for a period of 5—6 months, *viz.* from the middle of March (Phagun) to middle of September (Bhado) this period of storage is liable to fluctuation of 15 days at either end.

The period of storage may be divided into the first half (mid-March to the end of June) a period of high temperature, and dry weather, and the second half (July to mid-September) a period of high temperature, humidity, and heavy rain.

Problems in storage :—There are three main problems to be taken into account (i) method and facility of storage, (ii) climatic considerations, (iii) price value.

The method of storage varies in the villages of the same district the reason being that the cultivators are anxious to devise, and adopt methods that will help them to check, and lessen the percentage of damage in storage, provided they are convinced about the economy, and effectiveness of the method.

The majority of the cultivators do not have suitable facilities as regards space for storing the tubers properly since they cannot afford a separate store or godown, other than part of their over crowded small dwellings.

It was observed that the tubers were stored usually in couple of rooms of a single storied house, or in some cases in double storied houses. In areas where better storage methods are known, thereby resulting in less loss, larger amounts of tubers were stored. Climatic conditions in such areas were inhibitive to pest and disease development in the stores.

MEASURES ADOPTED PRIOR TO STORAGE.

Tubers from the fields are transported in bags or baskets to the houses, where they spread out, or stored in small heaps for a period of 3—6 weeks, in the shade to dry thus facilitating the "rubbing off" of the soil sticking round the tubers. The period of temporary storage is influenced by the incidence of the potato moth at this time, the moth lays its eggs in the eyes, and cracks of the tubers, later on from which the larvae emerge to damage the stored tubers. The high temperatures

prevalent affect the keeping quality of the tubers causing them to dry and shrivel, under poorly ventilated conditions causing Black heart of tubers.

Sorting :—After the tubers have dried, or during their temporary storage, they are sorted carefully to separate the bruised tubers, and remove the rotton, and decaying tubers that are thrown out.

During the first part of the storage, the sorting is done once in ten to fourteen days, during the second part of the storage the storting is done once in five to eight days, care being taken to see that none of the tubers are moist, or being attacked by diseased organisms, since at this time the spread of moist of the storage rots is rapid and destructive.

GRADING.—This may be done at the time of sorting or later on, just before the tubers are sold for seed. Grading is done carefully, since there is a substantial demand for the graded stuff, therefore is done on a large scale by the seed merchants in Bihar Sharif, and Patna areas, also by individual growers in other areas.

Grading is based on the size of the tubers, viability and presence of blemishes. Tubers are graded into four grades (i) over 1·25″ diameter, (ii) 1·0—1·25″, (iii) 0·5—1·0″ and (iv) below 0·5″, by dressing them over suitable sieves.

SAND.—During the first part of the storage period (mid-March to July) the tubers are stored between layers of sand in most parts of the province. The reason being firstly its attack, and the consequent damage by the potato moth a larvae is lessened, secondly the tubers remain prote increasing cool under stand, they do not dry as much ; the colo he same, at is slightly dirtied, and the freshness lost to an e beyond the

Usually clean, dry moderately coarse to f ivators therefore used, fine sand affords a better covering. ies of poor quality every alternate year, unless it is badly e tubers that were sold case it needs to be changed frequentl

from the river beds by labourers, and seed merchants carts ; it is cleaned by sievin antelope further in transit, and

The used sand is th by contact. The infected tubers houses, thus acting as se seedlings to different kinds of where the temperature there has been a marked amount of with clean water on diseases, in potato growing areas far being taken not to we storage centres, especially so in Bettiah, the development of s agalpur, and Monghyr districts.

METHODS OF STORAGE.

On a clean mud or pucca floor a layer of sand 2·0" thick is evenly spread, on this fairly clean, dry, as far as possible healthy tubers are then spread 6"—10" deep, then a layer of sand 2 – 3" thick is spread to form a protective cover. Tubers are stored in dark, poorly ventilated rooms.

In Gaya, Manbhum district, where the temperature rises high, the sand is lightly sprinkled with water, or covered with a layer of Paddy straw or "that," or "chattai" to keep the sand and tubers cool. In the cooler districts of Hazaribagh, Ranchi, where the temperatures are not high, or, in those areas where comparatively smaller amount of tubers are stored, or on account of carelessness, the tubers are spread on the sand, or an clean mud floors, or stored in small heaps without any sand cover.

2nd part of storage (July to mid-September) :—During this period, the tubers are removed from under the sand, because there is a danger of the tubers becoming wet.

Tubers are then stored in baskets one-half to three-quarter capacity, or on bamboo racks (machans) spread out in such a way to have ample space, in single layer. The baskets are kept two or three a top each other. Care is taken to see that the tubers are not unduly moist, and regular sorting is done.

Sprouting :—Is accelerated by high temperatures and humidity, as well as by the cessation of the dormancy period which usually lasts from 3·0—3·5 months, in most varieties. Dormant period of the tubers can be reduced by the production short resting varieties, such varieties would be useful in where two are three crops of potatoes are taken.

It was ing before time reduced the sale value of the tubers, couple of roo sprouts are broken during sorting.

double storied ho DOWNS.

are known, thereby there is no separate arrangement for tubers were stored. Usually the tubers are stored in the inhibitive to pest and dise cted part of the dwelling houses, so

MEASURES ADOPTED P otected. The rooms are cleaned and

Tubers from the fields are with soil and cowdung paste to to the houses, where they sprea outall cracks and crevices in the for a period of 3—6 weeks, in the shadare blocked up carefully, the "rubbing off" of the soil sticking r

period of temporary storage is influenced in some cases where the potato moth at this time, the mo ver roof is a pucca one, eyes, and cracks of the tubers, later on from mostly mud, well emerge to damage the stored tubers. The l mortar,

Every effort is made to make the store room, insect and rodent proof, generally resulting in a dark, poorly ventilated room because of (i) fixing up of chattais or tats as screens to keep out the light, and insects, (ii) the lack of windows and ventilators.

The pucca houses heat up to quite an extent during summer causing a higher percentage of loss due to Black heart and heat rot, while the mud houses are poorly ventilated, and during the rains become humid, as well as hot, accelerating the development and loss caused by prevalent storage organisms.

ASSEMBLING.

In Patna, Bihar Sharif, and other large storage area 90% of the seed tubers are distributed by growers and grower merchants, these latter have large godowns where seed potatoes are kept after being brought off from the cultivators, or stored on hire, before being sold to the "beoparis", for a period of 2—4 weeks. The tubers are carefully sorted, and graded in the Arhats, and stored either in baskets or on racks.

LOSS IN STORAGE.

This is caused by a number of factors, the important ones being (i) use of diseased and poor quality seed, (ii) varietal susceptibility, (iii) soil, (iv) cultural operations, (v) climatic conditions, (vi) human factors.

Diseased and poor quality tubers :—The use of poor quality tubers for seed, in recent years has been due to the increasing amount of loss in storage caused by insect pests and diseases, reducing the total amount of tubers stored.

Again during the last few years on account of increasing demand of seed tubers, and black marketing of the same, at the time of sale, prices have risen very high, beyond the scope of most of the cultivators. The cultivators therefore purchase from local agents, smaller quantities of poor quality tubers, or utilize the remnants of the tubers that were sold off for seed.

In many cases dishonest agents, and seed merchants supply diseased tubers, these develope further in transit, and infect the healthy tubers by contact. The infected tubers rot in storage, or predispose seedlings to different kinds of infection. In this way there has been a marked amount of dissemination of potato diseases, in potato growing areas far away from the main storage centres, especially so in Bettiah, Chitarpur, Ranchi, Bhagalpur, and Monghyr districts.

Varietal susceptibility:—Certain varieties are mo susceptible either to storage rots, or insect attacks. Sath and Phulwa varieties were observed to be more susceptible to the larvae of potato moth, and storage rots. Nainital and Darjeeling varieties were more susceptible to high temperature and, storage rots.

Soil:—The type of soil on which the crop is grown influences the keeping quality of tubers in storage and predisposition to certain diseases. In alkaline soils, tubers are readily attacked by scab, and Bacterial rots. In heavy soils, on account of excess of moisture in the soil, soil borne diseases like wilt, Rhizoctonia rot, wet rots, are prevalent for longer periods, and are not eradicated, thus causing heavier loss in the fields, and latent infection in stores.

Cultural operations:—A crop that has been heavily manured with higher dosage of Nitrogen than required, is readily attached in the field as well as in the stores because of greater succulence and thin skin of the seedlings, and tubers. Tubers dug up slightly before maturity, keep better in stores, being more resistant to storage rots.

During digging the tubers should be lifted carefully to avoid bruises and cuts, as these tubers are the ones to rot readily during transit, and storage. Secondary wound organisms easily enter and attack injured tubers causing decay, and consequent infection of healthy tubers.

Climatic conditions:—Play an important part in the incidence of pests, and diseases. Ordinarily above 35° F tubers, rot on account of the attack and development of fungoid and bacterial organisms. The loss in stores is highest during the second part of storage, when favourable conditions of high temperature (90—110° F) and high humidity (over 85%) prevail, for the development of *rots*.

The rise in temperature is caused by the climate, and poor ventilation of the stores due to blocking of the few opening, or windows, which is done during the first part of storage, to prevent insects and light from entering in, as also by keeping the store cool.

High temperatures, dry conditions, and poor ventilation induce loss by Black heart, and heat. As far as possible the temperature should be kept low.

Moisture in excess in the stores is caused by leaky roofs, high relative humidity, dampness because of the collection of rain water in ditches, and ponds, some of it is given out by the tubers during sweating. The presence of moisture encour-

ages the growth of micro-organisms at temperatures over 40° F. A relative humidity of 85—90 per cent. is suitable with proper aeraetion, and lower temperature.

Ventilation :—Is an important factor, the air circulation should be controlled, it should be sufficient to prevent condensation of moisture in stores, and maintain a relative humidity below the saturation point.

Human factor :—This is operative when the cultivators carelessly dig, and handle the tubers in transit to the stores. When they store moist tubers to which contaiminated soil adheres, thereby serving as a source of infection in storage. Damaged tubers are easily attacked by organisms, causing heavier loss in transit and storage. Careless sorting of tubers leads to greater contamination of healthier stock. Mixing of affected tubers with the stock for seed helps to disseminate the different diseases and pests far and wide.

DISEASES IN THE STORES, AND FIELDS.

Butler and Bisby (1918) reported 16 diseases of potatoes occurring in the different provinces of India. 13 different diseases were observed during the present investigations and are given in the chart at the end.

Generally the first crop is free from disease, but some times it may be attacked by any of the following (i) *Phytomonas solana cearum*, (ii) *Fusarium eumartii*, (iii) *Sclerotium rolfsii*, (iv) *Rhizoctonia spp.*, (v) *Fusarium solani*. These diseases are prevalent in moist or poorly drained soils, the infection being primarily from containated soil, or seed tubers. The per cent. of damage varies from 5—10 per cent., except in certain cases when it may be more.

Diseased tubers were collected from the new crop, during the digging operations, or when freshly stored for a short period, as well as in the Hill variety exported from Jaynagar, Darjeeling, etc. Tubers of the hill variety were moist, poorly sorted having soil adhering to the sides, as well as damaged all these factors accelerated the development of diseases in transit causing 10—35 per cent. of loss.

The second crop (late variety) was marked by damaged by the diseases mentioned, after a couple of months of growth.

Diseases in storage develope on account of the prevalent of moisture, high temperature, poor ventilation.

Severity of the disease is influenced by the variety, primary infection or injury, suitable environmental conditions, method of storage, care of the tubers in storage, condition of the stores.

The organisms are present in the stores, as the stores are seldom cleaned, or disinfected properly.

COLLECTION OF MATERIAL.

Diseased plants, and tubers were collected during the tours under taken. Specimens were examined and collected from the various fields and stores inspected. Different diseases after examination of the symptoms, and preliminary surface examination were labelled and collected separately to avoid contamination and mixing. The collection of specimens was made on percentage basis.

Cleaning of material :—Diseased tubers, and plant tissues were washed carefully under tap water, rinsed in distilled water, air diried in were cages to prevent further insect damage; next examined microscopically, before making isolations.

ISOLATION material collected was examined by noting the external symptoms, cutting sections of the diseased parts, or microscopical examination incubating the material in moist chamber for growth and sporulation of the isolates, making tissue transplants on potato dextrose agar, and observing the cultural characteristics.

Affected plant tissues were surface sterilized by dipping in 0·1% Mercuric Chloride for 1—2 mts. and rinsing in 50% alcohal, or in 2% Silver Nitrate for 1·5—2 mts. and washed in 4% Sodium Chloride (sterilized) solution. Tissue transplants were made on potato dextrose agar slants, grown at room temprature to observe the growth in culture.

Purification :—The isolates were purified by (*a*) successive sub-culturing, (*b*) hyphal tip method (Brown 1924) to ensure pure cultures of all the organisms isolated.

These purified cultures were grown on potato dextrose agar, and paddy media, at 20°c and 30°c under controlled conditions, to facilitate their identification, by inducing the development of different fructifications.

The following diseases were isolated, and identified as causing damage in the stores and fields.

BLACK HEART (Karia mugh). It is a major storage disorder being physiologic in nature. Mostly prevalent from May to mid-July. Causing a great deal of damage as it is often un-noticed. Black heart is due to suffocation of tubers caused by temperatures above 90° F, lack of Oxygen, and poor ventilation.

Symptoms :—Externally the tubers are darkar coloured in distinct patches. On cutting open severaly affected tubers, the slightly yellowish flesh-changes to pink, red, or brown, ulti-

mately becoming black in colour. In slight cases of attack the tissues blacken without much change in colour. Affected tissues remain firm and leathery. In advanced cases, the tissues dry out, forming cavities, the cells in the pith, and phloem are killed.

Area attacked depends on exposure to environmental conditions and severity of attack.

Control :—(*i*) Temperature of the stores should be kept low by sprinkling water on the sand. (*ii*) Storing tubers in raised walled stores having adequate ventilation.

HEAT ROT.—This also is a physiological disorder, caused by respiration of the tubers, and evaporation of the moisture. The loss is not as heavy, as in the case of Black heart. Tubers loose weight, and sale value. Tubers become shrivelled, wrinkled, having a rough and slightly furrowed surface. At times tubers are spongy, having more or less similar external appearance. On being cut it well be observed that the flesh is dry, and slightly grey.

Prevention :—Storing of tubers in cool well ventilated stores.

BACTERIAL SOFT ROTS.—Caused by *Erwinia* (Bacillus) *Carotovorus* Jones. In majority of cases the above organism was isolated from diseased tubers. The damage was sporadic, varying in incidence on account of the climatic conditions.

Affected tubers on cutting open were observed to have a dirty white flesh, with brownish margin, the margin being distinct. Tubers were soft and mushy, emitting a foul smell affected part usually disintegrated finally.

Under conditions of high humidity and poor ventilation, moth infested or injured tubers were readily attacked by the organism ; heaviest loss occurred during the months of July and August.

The disease in storage spreads by contact of the brownish liquid oozing out of the diseased tubers. Infection being through cracks, wounds and the eyes. Primary infection is from the soil, or from the dirt of contaminated fields.

"*Morphology*":—Organisms are motile, two to five peritrichous flagella 0·6—0·9u x1·5—3·5u. No spores or capsules were observed in chains. Gram positive. Not acid fast. Colonies on Agar, round, raised, smooth, grey white, glistening with entire margin. Optimum temperature being 25—30° C.

"*Prevention*":—Sanitary cultivation, and destruction of affected tubers, and plants.

DRY ROTS are caused by *Fusarium coeruleum* (Lib) Sacc. and, *Fusarium trithicoides* Woll. Both of these organisms are widespread, major diseases in storage prevalent

during the months of June to August, in mixed infections with wet rots, and in the field crop during the month of March, attacking newly dug tubers.

"*Symptoms*":—*F. Coeruleum* causes a dry rot, affected tubers have a depression, the centre being firm, the sides and margin being soft, the decayed area having a dark margin. In slight attack the flesh is dry and shrunken. If a badly affected tuber is cut open, bunches of bluish, or bluish white mycelium can be observed growing on the surface of the tubers, or in cavities, at times the mycelial growth emerges on the surface of the tubers through the cracks.

The initial infection is through the lenticels and wounds, from the contaminated soil, secondary infection being from contaminated stores and tubers. Small (1940) and Foister (1940) observed that the organism is soil borne, transmitted by tubers having moist soil adhering around them, or by mites and insects.

"*Morphology*":—Macroconidia dorsiventral, usually triseptate 31—40ux 5·0—6·0u Basal end is pedicillate apex blunt. Aerial mycelium felt like in old cultures, at times whitish to bluish white. Conidial mass brownish white to reddish ochre. Plecten chymatic stroma dark blue to indigo blue. Chlamydospores abundant in old cultures, terminal and intercalary, in chains and masses, circular and smooth.

F. trithicoides causes powdery dry rot of the tubers in storage, usually observed occurring under same conditions as *F. coeruleum*.

"*Symptoms*":—Diseased tubers are wrinkled and shrunk on cutting open the affected tubers were observed to be dry, corky, and disintegrating. Under moist condition the internal cavities were lined with pinkish or whitish tufts of mycelium all over the surface, the rotted tissues were discoloured brown to dark brown.

Primary infection is from the contaminated soil, through eyes and cracks. Mann etal (1924) mention it as a destructive disease causing 80% loss in Bombay presidency. They found that thin skinned varieties, and injured tubers were easily attacked in storage by the disease. If the crop was grown on contaminated soil it was predisposed to the disease in storage.

"*Morphology*":—Macroconidia abundant, pedicellate, microconidia scarce, comma type of spore usually observed, slightly donsiventral, uniform spores in powdery mass on aerial mycelium, latter on covering the surface. Chlamydospores

present, usually terminal. Mycelium abundant, white latter changing colour from pale flesh to salmon buff on potato dextrose agar. Macroconidia 2 septate 19—25u x4·0—4·5u 3 septate 20—33u x4·0—5·5u.

"*Prevention*":—(i) Growing of thicker skinned varieties, (ii) Destruction of diseased tubers, and plant parts, (iii) Crop rotation, (iv) Disinfection of the stores.

DRY ROT, (BROWNING) caused by *Fusarium solani (Mart) App. and Woll.* was observed in storage, and fields, in the latter case in newly dug tubers.

Symptoms :—A gradual sinking and wrinkling of the surface of the tubers occurs. Depressions on the tubers are scattered, having small white mycelial tufts In casses of severe attack, the tubers break down, and are attacked by bacterial organisms, finally causing a wet rot. Affected tubers become a rotten mushy mass, giving out a bad smell, because of the bacterial contamination. In freshly dug tubers a dry rot was observed.

Primary infection is from the soil, through growth cracks and injuries. Diseased tubers contaminate the stores, and other tubers in the case of a wet rot infection.

"*Prevention*" :—(a) Use of healthy tubers. (b) Careful digging, and handling of the tubers.

Morphology :—Microconidia abundant, circular and oval. Macroconidia broader in upper half, with slightly constricted apex triseptate conidia abundant 29 x 5·4u average, ranging from 26—35u x 5.2—5u lunate shaped, Sporodochia present. Chlamydospores circular, spined, intercalary and terminal. Aerial mycelium moderately developed, dirty white to greyish. On potato dextrose agar the substratum is dull violet black.

JELLY END ROT of the tubers caused by *F. radicicola.* The disease is more destructive in storage than in the field.

"*Symptoms*":—Diseased tubers have a typical soft rot at the stem end the affected part easily seperating from the healthy. The rot advances uniformly until the tubers become a slimy mass inside the skin ; at times the skin shrivels and dries up. Generally the rotted tuber emits a rancid smell, when not contaminated, otherwise with bacterial contamination a foul smell is given off.

The flesh of the affected tuber is slightly discoloured, in severe cases of attack, cavities are formed.

Initial infection of the tubers is due to contaminated stores, or the soil. Healthy tubers are infected by contact with the sticky liquid secreated by the diseased tubers.

"*Morphology*":—Macro conidia are usually triseptate, 30—44u x 3·7—4·5 u narrower than in the case of *F. Solani*, shorter and fewer septate than in *F. Eumartii*, slightly lunate, with blunt apex, chlamydospores are 7—9u, circular, spined, and Intercalary. On rice media cream to bluish green sporodochia are observed.

SCLEROTIUM ROT caused by *Sclerotium Rolfsii, Sacc.* is a wide spread major disease causing moderate, to heavy loss in stores, and the fields, during the months of August to October, and February to March, respectively.

In the stores having high temperatures above 90° F, and high humidity, the disease is destructive, attacking the tubers on racks, in baskets, and in heaps on the ground. It is also prevalent under similar conditions in transit, and in wet, or poorly drained fields.

"*Symptoms*":—Tubers are more or less covered over with stands of thick white mycelium. In cases of severe attack, four to seven tubers are bunched together, shrivelling up, and secreating a clear liquid which favour infection of the healthy tubers.

Sclerotial bodies are found in abundance, on the surface, they adhere to the tubers for quite a time. Under unfavourable conditions, irregular white patches, or thick threads of mycelium can be observed on the tubers. The tubers have a wrinkled appearance, and are leathery in touch.

Primary infection is from wet contaminated soil, or humid stores, secondary infection is from diseased tubers either in the stores or fields.

"*Morphology*":—Sclerotia are small, spherical, numerous, hard, brown, and becoming darker with age. Interior of the cut scleretia is hyaline, thick walled, with irregular compact cells 300—500u. Mycelium is coarse, strong, whitish, growing luxuriantly in culture, and on the host under favourable conditions, having moderate septations, 4·0—5·5u wide. Septations are 100—150u apart.

"*Prevention*":—(a) Disinfection of the store with 5% Phenyle, or 2% copper sulphate solution, (c) moderate irrigation of the fields.

FUSARIUM WET ROT is caused by *Feumartii, Carp.* This disease is mostly prevalent in stores, and to a lesser extent in the fields. The disease causes marked damage during the months of July to September, under conditions of high temperature, above 100°. F, high humidity, and poor ventilation.

"*Symptoms*":—The tubers become soft and mushy, exuding a clear liquid. The vascular bundles are discoloured brown, there being a distinct differentiation between the healthy, and diseased tissues.

Infection is from the diseased tubers in stores, and transit on contact with the liquid secreated by the diseased tubers. Secondary infection is from contaminated wet soils, the organism entering through growth cracks, wounds, and lenticels.

"*Morphology*":—Macro conidia usually 4—6 septate, 54-72u x 5·4-6·3u. Aerial mycelium poorly developed. Conidial masses found in exposed Pseudopionnotes, at first brownish white, later on gray to blush gray. Chlamydosphores 7—9 u, terminal and intercalary.

Prevention as given previously.

BACTERIAL WILT, or wet rot of tubers caused by *Phytomonas solanacearum* (*E. F. S.*) Bergey et al. This disease is widely prevalent in the stores, during the months of July to September, and to a lesser extent in transit, and the fields, during December, February and March.

"*Symptoms*":—Affected tubers are soft, with wrinkled, or smooth skin, emitting a foul smell. As the disease progresses, the flesh disintegrates exuding brownish coloured liquid, or viscous dirty white exudate, that discolours the tubers. The liquid froths out, from the eyes, or cracks on the surface, particules of sand, or soil, adhere to the tuber wherever it is moistened by the sticky froth. In cases of severe infection, the skin separates easily from the disintegrated mass.

The organism developes, and spreads rapidly in the stores at temperatures ranging from 80—100° F, coupled with high humidity. The disease is soil borne, primary infection being from wet, or poorly drained soils, or dirt, while the secondary infection is from contaminated tubers in storage, and transit.

"*Morphology*" :—Organism is motile, with single polar flagellum, 0·5 x 1·5u. No spores, or capsule present. Gram negative. On agar, the colonies were small, irregular, roundish, and smooth white, to yellowish brown. The optimum temperature being 35—37 C. "Prevention" (*a*) Proper drainage of the fields, (*b*) application of organic manures, and nitrogenous fertilizers to give an acidic reaction to the field, (*c*) Disinfection of stores with 2·0% copper sulphate, or 5% Phenol.

DISEASES IN THE FIELD.

LATE BLIGHT caused by *Phytopthora infestans* (Mont) DeB. was observed in the fields, during the last week of December for a period of one month. In the areas inspected, the disease caused a minor loss, the severity, being chiefly influenced by prevalent climatic conditions, *e.g.* winter rain in the last week of December, or fog and cloudy weather in January, and February. Woodhouse (1913) reported it as causing heavy damage in Bhagalpur district.

"*Symptoms*" :—A brown discolouration of the tips, and the margins of the leaves was observed. Affected leaves were slightly curled, and somewhat stunted. Only in a few cases limp blighted leaves covered with whitish aerial growth of the fungus were observed. Hill varieties were usually affected by the disease.

"*Morphology*" :—Mycelial growth present, septation of mycelium prominent in old cultures, no sporulation of the fungus observed.

Infection was primarily due to the use of infected seed specially of the hill variety, the early planting of these tubers inhibited the proper amount of exposure to high temperatures, thus enabling the fungus to survive in the tubers. Secondary infection is due to contact of the affected foliage with the healthy one, and by irrigation water in severe cases of attack.

"*Prevention*" :—(*i*) Digging of tubers only, when the affected foliage is dead, (*ii*) Wherever possible, planting the hill variety of tubers late, (*iii*) Pretreatment of tubers in hot water at 104 to 120° F for five hours, drying them in the shade later on, (*iv*) Spraying the foliage with a suitable concentration of Bordeaux mixture, whenever necessary.

EARLY BLIGHT caused by *Altenaria Solani* (*E. & M.*) *Jones and Grout*, was observed more frequently in the fields than the Late blight, the damage caused by it, however was slight.

The disease was prevalent during the months of February, and March, whenever there is winter rain. High temperatures, (above 85° F) and low humidity inhabit the disease.

"*Symptoms*" :—Typical, scattered, concentric, target board markings were observed, with a dark centre, and lighter coloured margin. Infection of the crop was due to the use of contaminated tuber, and from the soil, that served as a secondary source.

"*Morphology*" :—Mycelium light brown, and septate. Conidiophore brown, septate, erect 50—90×7—8 u. Conidia

mostly in chains 120—290u×12—20u, five to ten cross septate, having a few longitudinal septa, obclavate, brown, terminating in long septate hyaline beak.

RHIZOCTONIOSE caused by *Rhizoctonia solani* Kuehn was observed as a major disease in the fields, and in most cases in the stores, where the loss was appreciably high. It was observed during the months of August and September in the stores, in February and March in the fields.

"*Symptoms*" :—In the fields it was found developing at the base of the plants, or a light brownish mycelial mass. The tubers were infected in the soil, in majority of the cases sclerotial bodies were found adhering to them. The sclerotia were small irregular, or circular, brown or black, in colour.

In the stores having high temperatures, and humidity the disease developed by attacking the healthy tubers, thickish brown mycelial strands envelope tubers that are moist, or wet, gradually developing vigorously, and forming many minute selerotial bodies are before.

Woodhouse (1913) reported it as causing heavy damage in the fields, and in damp poorly ventilated stores in Bihar Sharif and Sabour.

"*Morphology*" :—Mycelium thick light brown, hyphae, branching at right angles, and running parallel to the parent hyphae. Septation 14—16u from the point of origin. Aerial mycelium is dirty white in the beginning, later on turning fawn coloured. Sclerotia minute, dark brown, clustered at the edge of the culture, and on the inside of the tubes. Sclerotia are composed of many short celled stout hyphae, irregular barrel shaped cells. Width of hyphae being 6·9—8·7u, cells measnring 80—85u, the sclerotia 130—170u. No perfect form was observed, in the isolation made.

"*Prevention*" :—(i) Pretreatment of tubers with Mercuric chloride at a concentration of one ounce in 7 gallons of water for two hours, (ii) soaking tubers in Chlorinated lime for 15 hours, in both the above cases the tubers are unfit for consumption.

WILT (BROWN RING) caused by *Fusarium Oxysporum* Schl., was observed in the fields, causing some damage in most of the potato growing areas at temperatures ranging from 70—90° F. Generally the affected plants were wilted, in severe cases of attack the plants withered, these were attacked by other soil organisms.

"*Symptoms*" :—Attacked stems were coloured light brown to brown. The disease was found to be prevelent in wet

soils, and poorly drained fields. In some instances the fungus mycelium was observed growing around the base of the stems, or in the soil adhering to the crown, and the roots.

"*Morphology*" :—Micro-conidia, unicellular, scattered or branched together at times 5—11u ×2—3·3u. Macroconidia dorsiventral, with pedicellate base, mostly 3 septate, 25—37 × 3·3—4·3u, sporodochia large, and scattered. Conidia in mass, salmon coloured, chlamydospores circular, terminal and intercalary unicellular 6·9·5u.

Primary infection was from the soil, secondary infection was caused by contaminated tubers, usually exported from the hills.

POTATO MOTH (*Phthorimea operculilla*) Zell. This insect is responsible directly, and otherwise for 45—75% of damage, and 20—50% loss of tubers in storage. Only such observations on the moth, and its larvae were made that were intimately concerned with the different diseases, since the study of the insect did not come within the scope of these investigations.

Practically in every case tubers damaged by the larvae were readily attacked by fungoid, and bacterial organisms, individual or collectively. Generally the starch of the tubers is broken into sugar, forming an ideal media for the infection, and growth of the secondary wound parasites, as well as other storage organisms.

Bacterial rots, wet, and dry Fusarium rots are transmitted from one tuber to another, by the larvae, and in some cases by the moth itself. The moth lays its eggs in the eyes of the tubers in the fields, wherever the crop is grown, in heavy soil, or when the tubers are drying in the shade before storage under sand, the larvae hatch out, and attack the tubers.

High temperatures (80—105° F) during April to June, or the cool East wind during the months of July to August, accelerates the growth, and the life cycle of the moth. Poor ventilation and high humidity also favour development of the moth, on the other hand, cold dry weather, inhibits the growth, and development.

Prevention :—(i) Fumigation of pucca stores with petrol vapour, or sulphur fumes for ordinary stores. (ii) Storing of tubers under sand intermixed with garlic; or spreading on racks covered with chattai, in an approximate proportion of half a seer of garlic to one maund of tubers, spread over, and covered by four maunds of dry sand.

Suggestions for storage of tubers :—These suggestions for storage are applicable, in particular to conditions is Bihar, where large amounts (over 100 maunds) of seed tubers are stored for a period of five to six months, under the prevelent climatic, and environmental conditions locally by most of the individual cultivators.

The storage of tubers is influenced markedly by the different factors causing losses, these very in different provinces or regions. Suitable, economical, and efficient methods of seed potato storage have been recommended by Mann et al (1924), and Uppal (1944) for Bombay presidency, by Dastur (1931) for C. P. and Berar. Some useful recommendations were made by Woodhouse (1913) for storage of tubers under Bihar conditions.

The method, suggested below can be adopted by a large number of cultivators, seed merchants, and well to do literate farmers, who store potatoes on a moderate to large scale. The poorer cultivator may not be able to adopt all the suggestions given, however he could follow a number of them according to his means.

It would be possible for an association of farmers or seed merchants, or zamindars to start a cold storage plant on Co-operative basis, and run it successfully. The cold storage is advantageous, in as much that storage rots do not develope at 36—40° F sprouting does not take place, and the tubers can be stored successfully, as well as economically, provided the hire, and running costs are reasonable.

The following points may then be kept in mind while storing tubers.

(*a*) Healthy tubers, under good conditions of aeration can be successfully stored on racks, covered with chattai, in moist stores, or godowns.

(*b*) Tubers should not be stored, or heaped on damp, or wet floors in hot, and poorly ventilated stores.

(*c*) If the floor of the godown is kuchha (mud) it should be raised a foot high, by placing bricks, and plastering them, if the floor is pucca, it should be covered with sand to keep it cool.

(*d*) Tubers should be stored in diffused light, or in the dark to avoid drying, because of the transpiration, sprouting, and greening, of tubers, caused by exposure to heat, and light.

(*e*) Tubers should be carefully dug, and handled, so as not to be damaged, Larvae attacked, and injured tubers are readily attached by wound organisms.

(*f*) Tubers should be fumigated within 10—14 days of harvest, either by Petrol vapour or sulphur fumes (Mann 1924).

(*g*) Tubers stored under sand should have pieces of garlic mixed. Half a seer of garlic, being enough for a maund of tubers.

(*h*) Clean dry tubers should be stored, to avoid generation of humid heat, caused by the storage of moist tubers. Dirt adhering to the tubers is a source of dissemination of Fusarium, and Bacterial rots.

(*i*) Well ripened or mature tubers should be stored, since immature tubers loose moisture thus inducing the development of organisms.

(*j*) Stores, or godowns should be disinfected with 10% Phenyle, or 5% copper sulphate.

(*k*) Ventilators should be opened in the morning, and evening, but be closed during the day, to prevent hot breeze, and light from affecting the tubers. Poor ventilation causes suffocation of the tubers.

(*l*) Tubers should be stored under clean dry sand to prevent larvae infestation, keep the tubers cool, and avoid contamination, by the use of dirty sand.

(*m*) Tubers should not be stored more than 9—12″ deep, otherwise there is a danger of rotting, in the layers, or heaps.

(*n*) The stores and go down should be inspected once in ten days, or a fortnight, and the turbers sorted, the diseased, and badly damaged tubers being properly destroyed.

(*o*) Tubers of different varieties should be stored separately if possible, to avoid mixing, and contamination.

(*p*) The store should be situated in a dry cool place, if possible under the shade of tree, protected by other buildings. Underground rooms or cellars that are dry, and have low temperatures are suitable as well. Floor must be plastered, or cemented and perfectly dry. Rooms should be well ventilated, door and ventilators be fitted with wire gauze, or fine mesh to check the entrance of pests. Walls should be crack, and crevice proof, and disinfected, or coal tarred at the bottom as a precaution.

Methods recommended for control of diseases :—These are general suggestions, and in most instances can be adopted successfully and economically, by the cultivators,

and recommended by the Departments of Agriculture in the province, and states.

The chemical methods of control could be tried individually, and collectively by the wealthir and educated farmers, (agriculturists), seed merchants, or others interested in the subject.

The commonly used chemicals for the control of the different diseases have been given for the diseases observed.

1. Weeding, collection, and destruction of disease or larvae attacked plants, and tubers.
2. Careful handling, drying, and sorting of tubers to lessen the amount of injury, excess of moisture, and affected tubers in stores.
3. Growing of recommended, and disease resistant varieties.
4. Use of pure, healthy seed tubers, that have been certified as good.
5. Practising of suitable crop rotation wherever possible.
6. Checking the movement of contaminated seed, manures and implements from one area, or field to another.
7. Disinfection of stores with 2—5% $CuSo_4$ or 5—10% Phenyle as the case may be, to prevent contamination of tubers in storage, and act as a fungicide.
8. Moderate, and careful irrigation to avoid excess of soil moisture, and thus check the spread of soil borne diseases.
9. Growing the crop in a uniformly level field with good drainage thus preventing water logging, and irregular moist patches.
10. Storing the tubers in a cool dry, well ventilated place, preferably on bamboo racks.
11. Growing of pure seed tubers, and storage of the same, separatelly, for stock purpose.
12. Practising mass selection wherever possible.
13. Disease, and moth infested tubers should be properly dried, and destroyed by burying them in a 5—6 feet deep pit, or burning them with 20% Sulphuric acid, or fire.

These tubers should not be thrown in the fields, or near the stores, as they serve as a source of contamination.

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DISEASES OF POTATOES IN BIHAR.

Chart showing the damage, and time of prevalence of the important diseases.

No.	Disease	Organisms	Place of attack	Time of prevalance	District	Per cent. of loss
1	Bacterial wet rot	Phytomonas solanacearum	Storage Field Transit	Last week June to mid-Sept. Feb. —March Sept. —Oct.	Universal	30—50%
2	Dry Rot	Fusarium coereuleum	Storage	Mid-May to Mid-July.	do.	20—25%
3	Powdery dry rot	F. trichothecoides	Storage	Mid-May to Mid-July.	do.	15—20%
4	Sclerotium rot	Sclerotium rolfsii	Storage Fields	Aug. — Sept. Dec. — Feb.	do.	20 — 25%
5	Wet rot	Fusarium eumartili	Storage Field	Aug. — Sept. Mid-Dec —Mar	Gaya, Patna, Hazaribagh, Muzaffarpur Darbhanga, Arrahr.	10—15%
6	Winter rot	F. solani	Storage Field	Mid-Aug. to end of Sept. Dec.—March	Ranchi, Gaya, Patna, Daru, Bettiah.	7—15%
7	Jellyend rot	F. radicicola	Field	Dec. to March	Hazaribagh, Patna, Muzaffarpur, Saran	5— 7%
8	Rhizoctoniose-	Rhizoctonia solani	Storage Field	Aug. — Sept. Feb —March	Patna, Gaya, Bettiah, Chapra, Darbhanga.	5—10%
9	Wilt	Fusarium oxysporum	Field	Dec —March	Practically in all of them.	5— 7%
10	Bacterial soft rot.	Bacillus carotovorus	Storage	Mid-May to August.	Universal	10—15%
11	Black-heart	Physiologic	do.	April—June	Patna, Gaya, Palamau, Sahabad, Chapra, Darbhanga.	15—20%
12	Heat rot	Physologics heat	Do.	April—June	Patna, Gaya, Sahabad, Bhagalpur, Palamau.	5— 7%
13	Late Blight	Phytopthora infestans	Field	Mid-Dec to Mid-January	Patna, Bettiah, Darbhanga, Muzaffarpur.	3— 5%
14	Early Blight	Alternaria solani	Do.	February and March.	Gaya, Hajipur, Hazaribagh.	5— 7%

REPORT ON A DETAILED STUDY OF METHODS OF YOKING BULLOCKS FOR AGRICULTURAL WORK PRESENTED TO THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.*

By M. Vaugh, Agricultural Engineer, Allahabad Agricultural Institute.

This is a report of a study which is part of a larger programme of research being carried out at the Allahabad Agricultural Institute on the methods of yoking bullocks for agricultural work and on the effect of body conorrmation on draft ability of work animals. This report will deal with the study of yoking methods, yokes and harness.

The main object of the whole scheme was to secure information on the effect body conformation has on the draft ability of work cattle. This information, especially if a positive correlation were found, should provide a basis for selecting breeding animals. If readily measured or recognised body measurements can be determined which are consistently associated with high draft ability, they should be a valuable guide to the animal breeder in selecting breeding stock. We wished to determine how far any such measurements associated with draft ability coincided with body measurements or proportions known to be consistent with milk yielding ability. We particularly wished to determine how far simple measurements, which could be made by ordinary breeders without elaborate apparatus or much knowledge of genetics, could serve as a guide to the selection of breeding stock. We believed that the results of such a study, even if negative, would be of value. It would show that some basis of selection other than such measurements is necessary. Information as to the extent to which a certain body conformation is desirable or necessary for maximum draft ability would help to settle the controversy over whether it is possible to have a dual purpose breed or not.

If we were to test the draft ability of the animal, it seemed necessary that the animal be tested with a yoke or harness which enabled it to exert its maximum strength. There are widely differing types of yokes in use in India which appear to differ in the extent to which they allow the animal to use his strength. Aside from its bearing on this scheme, information about the effect of the yoke

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on the ability of a pair of animals to pull a load would be useful in practice. If yokes really differ as much as they appear to, there should be marked advantage in selecting the best one for general use. The adoption of a yoke which would increase the power delivered 10 per cent. would be equivalent to adding the power of about 5,500,000 work animals to the power available to the Indian farmer. (There are 55,794,864 bovine work animals in India British India and the Indian States taken together,—according to the 1940 census of live stock). It seems desirable therefore to carry out tests to determine the best type of yoke or harness before trying to test animals. It is with this preliminary work on methods of yoking that this report is concerned.

Some further statement of the importance of the problem studied may be of value. The Indian farmer is practically entirely dependent on the draft bullock or buffalo for power used in farm operations. The power developed by a single pair of bullocks is small but the aggregate of all power used on the farms of India is very large. If the average power developed per animal is as little as one-fourth horse power (H.P.) the aggregate is nearly 14,000,000 H.P.

It seems unlikely that animal power will be displaced in the near future in India. The small size of individual holdings, the poverty of the individual farmer, the dense population, the lack of fuel oil and other factors are all against the extensive introduction of mechanical power for the work now done by bovine animal power. Even if mechanical power is to replace animal power, the period intervening before this is likely to take place on any large scale seems likely to be long enough to justify study of the best method of application of animal power.

It is well recognised that the Indian farmer is hampered by lack of power. One of the most common excuses for not accepting better implements, particularly ploughs, is the supposed inability of the bullocks to deliver the required power. The only effective way to increase the productive power of the farmer to any great extent is by enabling him to do more work, or better work, in a given time. One of the most effective ways to do this is to put into his control more power per worker. Without any essential change in the present system of cultivation, the provisions of more power will improve the position of the farmer by enabling him to do better work, to do more work, and so to increase his earnings. This improvement will be in addition to anything which may be accomplished by better seeds and better farm practices.

In fact most better farm practices ultimately depend on better implements and more power to work them. At present, Indian work cattle seem to develop less power than should be expected of them. Aside from any question of improving the bullock, any improvement in the yoke used which will enable the bullock to better apply his strength will be a gain.

Review of the literature

Very little testing of draft animals has been done anywhere in the world, so the literature on the subject is scanty. Rule of thumb methods have developed various types of harness and of yokes in different parts of the world and even in different parts of a country, as in India. Very few of these seem to have been subjected to scientific study and none seem to have been developed as the result of study and systematic tests of different types.

It is known that draft ability in both horses and bovine animals is roughly proportional to body weight, that the big animal in general can pull more than the small. A good deal is known by farmers in western countries about the fitting of collars to horses, for instance, and there are references in the literature to the sore shoulders resulting from poorly fitted collars or other causes. Occasional references can be found to the advantages of a 'well-fitted yoke'. Our study has not uncovered a single comparative study of the fitting or design of either yokes or harness. No article has come to our attention discussing the subject as the main item of the article.

It is not difficult to understand reasons for this situation. The art of using animals for draft work is very old and the main types of harness and of yokes were fixed long before the age of scientific enquiry. When men first began in modern times to question all sorts of practices and ideas, perhaps the harness or the yokes in use functioned relatively better than other things. Attention therefore tended to be focused where most difficulty was felt, on the implements used with the animals. Except for the appearance of galls and sores there was no very sensitive method of judging the fatigue of the animal. By the time that the spirit of enquiry had spread sufficiently and the numbers of research workers had increased to the point where such problems might have had more serious attention, the development of the internal combustion engine, applied particularly to the tractor, had progressed to the stage where it seemed likely to displace animal power in agriculture. If animal power was to be

displaced, there seemed little value in studying it or in trying to improve it or its application. This probably largely accounts for the scarcity of literature on the subject.

A few efforts have been traced to improve yokes in India. Krishnamurty of the Madras Veterinary College designed an improved yoke but it was not included in the types of yokes reported in common use in Madras by the Director of Agriculture. Similarly, Mushtaq Ahmad of the Punjab Veterinary College designed an improved yoke which was not included in the types reported by the Director of Agriculture Punjab, in response to our enquiries for designs to be tested. A 'yoke' or wooden collar was designed for a single bullock at Poona Agricultural College and was included in the types submitted by the Director of Agriculture, Bombay, and a similar yoke with no reference to origin was included in those reported used in Gwalior. Charley at Coimbatore designed a leather strap harness for a single bullock, described in leaflet No. 85 of the Department of Agriculture, Madras. No publication which has come to attention gives any information on comparative usefulness of any of these, the published material being confined to descriptions and to the uses to which they may be put. In some cases, authors make claims of superiority but do not cite tests to prove the claims. No foreign publication has come to our attention from anywhere in the world dealing with tests of harness or yokes. The field therefore seems to be a completely virgin one, unexplored and apparently practically undiscovered.

The literature on the testing of animals is scant but not quite non-existent. Bulletin 240, October 1926, of the Agricultural Experiment Station, Iowa State College of Agriculture and Mechanic Arts, by Collins and Caine, devotes 28 pages to 'Testing Draft Horses'. This is the only publication in English devoted primarily to discussing tests of draft horses which has come to our attention.

'Investigation of the Working Performance of Swiss Cattle' by Hans Wenger, Bern, 1939, is the only study of the draft ability of bovine animals which has been available during this study. It is in German and no English translation has been found. Wenger lists a bibliography of 58 items, only three being in English, one a work on statistical methods, on the bulletin by Collins and Caine referred to above and the third a study by Brody of Missouri University. From a translation of the index and summary, it does not

appear to contain anything on the question of harness or yoking nor does the bibliography refer to any publication on the subject.

With such a scarcity of work done on draft power, it is not surprising that there is little material available on methods and equipment for testing draft power. Wenger gives a detailed description of the loading car which he used, which is of the general type described by several other workers, particularly Collins and Caine.

Collins and Caine in Iowa State Bulletin 240 describe three variations of a traction dynamometer car for testing animals as follows:

'In the first dynamometer, built for this work, provision was made for hitching each of two horses to weights in a manner similar to that shown in fig. 2. In this case the tractive pull resulting from lifting the weights is more than enough to propel the dynamometer and it is necessary to apply some resistance to hold the machine back. This was done by gearing the rear wheels to a rotary pump and then regulating the discharge from the pump to produce the desired resistance. This regulation was made automatic by connecting the valve so that it is operated by a change in the height of the weights relative to the frame.'

'When the weights are at the bottom the valve is closed and the rear wheels are locked. As the weights are lifted the valve gradually opens until at the top it is wide open and the pump furnishes a minimum of resistance. In action this automatic control allows the dynamometer to move just fast enough to keep the weights suspended whenever the team is moving. The condition of the road surface or the grade does not affect the amount of work done by the team but merely requires that more or less resistance must be furnished by the pump. The tractive pull exerted by the team is constant and equal to the sum of the weights which are held suspended.'

'In action, then, the tractive force required to move the dynamometer (variable) plus the resistance furnished by the pump (governed by position of weights) is equal to the tractive pull exerted by the team (constant). The dynamometer, of course, has practical limits. On slippery roads it is difficult to get enough traction for the wheels, in which case the weights would not be lifted and the team would be exerting a tractive force something less than the weights. On the other hand where the roads are extremely soft or a very steep hill is encountered, it is quite possible that the tractive pull

required to move the machine itself will be greater than the amount of the weights. This may readily occur if only a light load were applied. In such a case the weights would strike the top of their guides and the team would be exerting a greater tractive pull than the amount of the weights.'

'The dynamometer as built was equipped to furnish a tractive resistance for each horse which could be varied from 60 to 350 pounds.'

'In order to test horses for their maximum effort for short periods, a larger machine was built. This dynamometer is shown in figs. 5 and 6. This operates in essentially the same way as the smaller machine just described but differs in constructional details and in capacity. In the construction of the machine, the chasis of a Nash quad four-wheel drive truck was used. The engine of the truck was replaced with a rotary pump so that the same train of gearing could be used to drive the pump. The team in this case is hitched to a double tree and only one set of weights is used. The weights are made of reinforced concrete and normally rest upon the frame as shown. Each of the weights may be attached to the weight beam by turning a lock on the beam. The valve controlling the discharge from the pump is so connected to the weight beam that the valve is closed when the beam is at the top. By this means the forward movement of the truck is regulated automatically so that the weights will always be lifted while the dynamometer is in motion. This machine has a maximum capacity of 4,100 pounds tractive pull and a total weight of 10,000 pounds.'

'The machine shown in figs. 7 and 8 was also built for testing horses for their maximum effort. It is mounted on the rear of a Ford truck chassis and as the engine was not removed, the truck can be readily transported with its own power. The large weights used are cast iron disks weighing 250 pounds each. As many of these as desired may be attached to the lifting cable. Small increments of weight may be added by placing them in the space provided between the two top weights. As shown in the diagram (fig. 7) a pulley is so connected to the cables that 500 pounds tractive effort is required on the hitch to support each 250 pounds weight. This was necessary in order to keep the total weight of the machine as low as possible. A special sprocket attaches to the rear of the worm shaft and drives the pump by means of a roller chain. The lever operating the pump discharge-valve is connected to the weights, so that the valve is closed when the weights are resting on the frame and wide open

when the weights are at the top of their guides. By this means, just enough resistance is automatically applied at all times to the forward movement of the dynamometer to keep the weights suspended. The height at which the weights are carried depends upon the speed of the team, the amount of weights attached and the road surface, but is of no importance as long as the weights are not touching either the top or bottom of the guides.'

'This machine has a maximum capacity of 3,200 pounds tractive pull and a total weight of 5,230 pounds. In order to get enough traction for average road conditions, it is necessary to use skid chains on the rear wheels and to put a skid under the front wheels as shown in fig. 8. For loads very near the maximum, additional weight is applied to the truck body. This is usually accomplished by getting men to stand on the platform.'

'For transportation it is only necessary to disconnect the tongue and skids, load them on the platform and take off the roller chain which drives the pump.'

'This type of machine has been further improved by the addition of a three-speed auxiliary transmission with power take off attachment. This provides six forward speeds for transporting the machine, and the power take off provides a more suitable method of driving the pump; otherwise no important changes have been made. The machine is illustrated in fig. 9.'

It will be noted that the first dynamometer car described by Collins and Caine and those described by European workers are designed to give working loads. The two latter described by Collins and Caine are designed primarily to test maximum draft ability, though by suitable adjustment it is possible to use them for smaller loads also.

Broady and fellow workers used a tread mill apparatus instead of a loading car, which they have described in Missouri Bulletins 209 and 383. The principal of the tread mill is that the backward push of the animal's feet tends to move the travelling belt on which the animal stands. This allows the animal to stand in one place, which may be under a shelter. In this way it is possible to have a uniform unvarying footing on which the animal works and which is independent of weather conditions. They first experimented with loading the animal by using the tread mill to drive an oil pump in the same way as was used on the Iowa loading car

by Collins and Caine. This proved unsatisfactory, possibly due to the tread mill being in bad mechanical repair. They later loaded the animal by making it lift weights.

M. A. Sharp described a simple traction dynamometer for maximum draft tests in Vol. 22, No. 1, dated January, 1941, of the Agricultural Engineering Journal. This consists essentially of a two-wheeled cart made from the back axle of a lorry or car with a platform and draft rig added to it. It also carries a roller, on which a rope can be wound, fitted with brake drums and brakes, which, when tightened, resist the rotation of the roller. The roller is also geared to a device, such as a car jack, which can be used to progressively set the brakes as the roller revolves. Rotation of the roller is secured by unwinding the rope, the other end of which is fastened to a tree or stake. The apparatus is prepared for a test by winding the rope on the roller with the brakes slack and the team or single animal hitched to the car. As the animal moves forward, the rope is pulled off the roller, setting the brakes and increasing the resistance to rotation of the roller. As the car can only move forward as the rope is allowed to unwind from the roller, increasing the resistance to rotation of the roller also increases the resistance to forward movement of the car. The animal or animals continue to go forward till the resistance of the car equals the effort they can or will exert under the degree of urging applied. In this case the pull rises continuously to a maximum and must be measured by some indicating or recording device interposed in the hitch from the animals to the car.

There is somewhat more literature on recording apparatus for measuring draft. Most commercial apparatus available is very expensive and not available in India and difficult to import in wartime. Even if available, none of it seemed entirely satisfactory in one or another respect. The greatest drawbacks, however, were non-availability and cost. Collins describes the Iowa traction intergrating dynamometer. This instrument is fairly suitable for use with some types of apparatus but did not seem suitable for our purpose, in addition to being unavailable in reasonable time. The bibliography at the end of this report gives references to various articles on recording apparatus.

Experimental Procedure

The decision as to which type of apparatus to use was difficult. It was finally decided to use two types of apparatus for the different parts of the experiment. Sharp's simple

dynamometer car for the testing of yokes and a tread mill for the testing of animals. This choice was partly dictated by the fact that the dynamometer car could be cheaply and quickly made available while the tread mill had to be constructed and would take time. The tread mill type of apparatus was chosen for the latter study of effect of body conformation on draft ability because it facilitated the use of certain auxiliary apparatus which will be discussed in the report on that part of the study and because it made standardization of conditions easy.

The lack of any satisfactory recording type of apparatus made it necessary to choose an indicating method of measuring the draft. Not even an indicating dynamometer scale was available, so a large Salter's spring balance was adapted to the purpose by adding a second pointer which would record the maximum pull exerted in any one test. While this has worked reasonably well, it is hoped that a recording unit will be available in the second part of the study.

The choice of just what to measure was even more difficult than how to measure it. It was recognised that animals do not, when doing ordinary work, continuously exert the maximum power of which they are capable. A commonly accepted standard for loading horses is that the ordinary draft should not exceed one-tenth of the live weight. The Physiological Chemist in the Scientific Reports of the Imperial Institute of Agricultural Research, Pusa, 1933-34, in reporting some tests carried out at Pusa, says, 'In these tests the draft has been one-fifth to one-sixth, (of the body weight) and yet the animals did not show any suffering.'

What we wanted to know was the maximum load which a given animal could pull in ordinary kinds of work for ordinary work periods, day after day. Theoretically, this meant a load which would result in a state of fatigue at the end of the work period, beyond which it would be undesirable or dangerous to go. We found no method of testing the state of fatigue and no standard maximum state of fatigue which an animal could bear. It is known of course that if an animal or a man works beyond his normal capacity, he loses condition, becomes leaner and eventually may develop other symptoms, or even collapse entirely, if the overloading is carried to great extremes. Such effects ordinarily only show up after long periods, too long at least for us to use them for purposes of this research. Various methods, such as blood analyses, were suggested as 'possibly' offering a means of determining fatigue. These did not seem

suitable because there was no standardized procedure or any correlation known between the results of the analysis and the degree of fatigue. To have tried to work out such standards would have taken more time than was available. Collins and Caine say 'It is practically impossible at present to determine the state of fatigue of an animal. Experienced horsemen may observe the general condition of an individual but they cannot determine the actual physical condition and know exactly if the horse is approaching a state of fatigue. In two years of experimental work where horses were pulling loads equivalent to a horse power or more for eight hours per day, day after day, they showed no outward signs of a fatigued condition; . . . .'. Since we found no end point which could be definitely determined, in tests using loads comparable to ordinary working loads, it was necessary to choose something for our tests which could be definitely determined. We realized that we do not yet know exactly the relation between the maximum load an animal or pair of animals can pull and the load they should be expected to pull day after day. Horse pulling contests and other testing in America has shown however that, in general, pulling contests are generally won—that is, maximum pulls are made—by animals which are known to be good workers. We, therefore, feel justified in assuming that in bullocks also, there is a relation between maximum load pulled and draft ability as generally applied under ordinary working conditions.

The applicability of the maximum pull to testing of yokes seems even more definite. Presumably, ability to pull a given load will be limited by one of two things, the strength of the muscles or the unit pressure under the yoke on the neck. The unit pressure under the yoke as the result of a given draft load will depend on the shape of the yoke and of the animal's neck—on the fit of the yoke to the neck. Tests of yoke to determine whether a difference in the area of contact enables a bullock to pull more or not seems to be one valid test of yokes. If it can be determined that changes in the yoke do not result in increased load pulled, it seems valid to assume that the load pulled is limited by the muscular power which can be applied by the animal. Since we were not able to find any alternative test which seemed to offer any advantage and since the results to be secured by tests of maximum pulling ability seemed theoretically valid, we feel justified in using tests of maximum load pulled in both parts of the scheme.

It is desirable, however, that tests be carried out to determine the fraction of the maximum pull which can be consis-

tently pulled by working animals. While as stated* above, one-tenth of the live weight is generally accepted as a suitable standard for horses, there is little or no experimental evidence to support it, and the information we have seems to throw doubt on it as a standard for bullocks. Desirable as it may be to have the information, it is outside the scope of this research problem.

As a preliminary step in the procedure, requests were sent to the Director of Agriculture of each of the provinces and of the larger Indian States known to have organized Departments of Agriculture, asking for dimensioned sketches of the typical yokes in use in their respective areas. These requests brought replies with drawings. These drawing were studied to determine what variation there was among them, and 15 types were selected as representing all the differences likely to in any way affect the usefulness of the yoke. Others appeared to be different only in ornamentation or other similar unimportant details. To these we added the 'Nagpuri' yoke in use at the Institute and one made to dimensions from the Almora hill district, making a total of 15 yokes selected for later testing. Two other yokes were made and tested to check certain points, making a total of 17 yokes actually tested. A yoke was made to the design of Krishnamurty of Madras Veterinary College. This is primarily a cart yoke and it was found impracticable to test it with the apparatus we were using. As it did not seem to have any advantage likely to justify further attempts to test it, it was excluded from the tests. Sketches of these yokes are shown in Fig. 1 and Fig. 2.

Experimental data and results

For the testing of the yokes, five pairs of bullocks were selected from the work animals regularly in use on the Institute Farm. A ploughman accustomed to handling the bullocks was also selected from the farm workmen and all tests were driven by the one man. Whenever he was off duty for any reason, testing was suspended and the staff was occupied in other duties connected with the research. All tests reported were done with the original five pairs of bullocks. On the few occasions when any one animal was indisposed for any reason, it was always possible to carry on with another pair. No major illness or injury to any of the test bullocks occurred during the period of the tests.

The tests were carried out by Mr. P. K. Bhargava and Mr. B. K. Mukerjee. Generally both were on duty when test

* Bulletin No. 240, Iowa State College of Agriculture and Mechanical Arts, p. 219.

were under way, and readings were confirmed by both. On a few occasions, when it was necessary for one of them to be absent, the other carried on the testing alone. These occasions were few.

Testing was started with yokes Nos. 1, 2, 3 and 4, which were first ready. The procedure was to first accustom the animals to the apparatus and to the new yoke when a new yoke was taken in hand. Then 25 pulls with each pair on a yoke was made before the next was taken in hand. When the full number of test on one group of yokes was completed with one pair of bullocks, the other pairs were used in turn till the whole group of yokes had been tested by all five pairs. In the meantime, another group of yokes, Nos. 5, 6, 7 and 8 were made ready and tests carried out. In this way the first 15 yokes were tested a total of 1,875 observations.

During these tests certain difficulties were met. The bullocks were totally unaccustomed to the particular type of work and to the slight noise the machine made. They were only accustomed to the ordinary field work of the farm and to the ordinary methods of driving, and it was found difficult to control them in any uniform manner. Sometimes they tended to move quite fast and at other times they required considerable urging. It was difficult to apply a uniform degree of urging so that they put out the same degree of effort every time. They tended to learn that they could only go so far before the machine stopped them and to be quite willing to stop when they had reached what they estimated to be the right place. This was partly overcome by driving them in different directions and by the changing of the testing from place to place. Some interruption was caused by rain on certain days and it was necessary to suspend testing for some days towards the end of the rains because the footing was unfavourable when the ground became very wet and covered with slime.

As we neared the end of the first series of tests, an attempt was made to analyse the results. The results were averaged, plotted in various ways and studied statistically. There appeared to be quite significant differences between the pairs of bullocks, but the differences between the yokes were not statistically significant. Study of the data seemed to indicate that it did not prove the lack of difference between yokes, but rather that our testing had not been under sufficiently controlled conditions, particularly with regard to the handling of the bullocks. The data showed too great difference between the high and low readings, indicating that in some

cases the bullocks had exerted abnormal effort and that in others they had shirked. Results of every test had been recorded in an attempt to avoid anything which might resemble 'doctoring' the datta. The effect was somewhat that of including in a series of analyses for nitrogen, samples into which flies had fallen in the course of the digestion.

Whether to include any given test or not presented a real difficulty. Obviously, when the bullocks ran and came up at the end of the test with a jerk, the maximum pull would be abnormal and it was easy to discard such test. Tests when the bullocks shirked were more difficult. Determining the standard of urging to be used was not easy. It might vary all the way from whispered commands to severe beating. This seemed to be the biggest variable and the most difficult to control. It seemed definite that we should not determine which data to record by the magnitude of the reading. It was decided therefore, after consulting with Dr. Sukhatme, Statistician of the Imperial Council of Agricultural Research, to again run through the tests, using a fewer number of trials of each yoke and attempting to control the conditions more carefully. We decided to try to determine which trials to discard before reading the dynamometer scale by carefully watching the animal during the test.

We, therefore, randomized the order in which the yokes were to be tested and ran the whole 15 again, making only five tests on each yoke and using one pair of bullocks. When this series of tests was completed and the results were studied, it appeared that they were more consistent than the first series. To make sure, we again ran a similar series of tests, with a new randomization order, making five tests each. There such replications were made to see if we could duplicate the results. The results of the replications were consistent, showing only the variation which would be reasonable when working with animals. The resuls of the three replications of five tests with each pair of bullocks were combined, and an average taken for each pair with each yoke was calculated. Table I gives these averages of 15 tests with each yoke and each pair.

While the yokes are classifiable into definitely different groups, the difference as shown by these tests is not large. The second group gave pulls averaging about 98 per cent. as great as the average pull of the first group or 97 per cent. of the pull given by the best yoke, No. 3. The other groups gave pulls 96 per cent., 95 per cent., 89 per cent. and 82·5

TABLE I

Average pull of bullock with double yokes

Bullock		Pull in pounds for each yoke (Average of 15 observations)																	
Team No.	Weight in lb.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Average
34 & 35	1,515	812	847	885	815	622	841	775	775	810	808	804	799	788	739	791	823	745	793
15 & 24	1,795	919	899	890	945	688	909	892	911	884	931	931	882	879	898	913	856	814	885
32 & 36	1,455	872	902	908	920	737	926	857	924	882	870	898	889	877	893	901	847	805	877
3 & 4	1,625	923	953	919	885	824	800	836	894	875	857	878	837	880	910	881	859	809	866
13 & 14	1,425	833	752	791	775	735	797	768	767	760	716	845	769	771	806	773	779	737	775
Average pull per yoke	..	872	861	879	868	721	854	826	853	842	836	870	835	839	849	852	852	782	..

STATISTICAL ANALYSIS OF THE ABOVE RESULTS

TABLE II

Analysis of variance for the double yokes

Due to	D.f.	S.S.	M.S.	F by calculation	F from table		Level of significance
					5%	1%	
Bullocks ..	4	2,674,114·2	668,528·5	41·31	2·52	3·65	1%
Yokes ..	16	1,669,996·2	106,249·8	6·59	1·81	2·32	1%
Interaction ..	64	1,030,531·2	16,102·1	12·31	1.	1·38	1%
Residue ..	1190	1,546,247·2	1,299·4				
Totals ..	1274	6,920,888·8					

Grouping of yokes

I	III	V	VII	VIII
3, 1, 11, 4,	6, 8, 15, 2, 14, 9, 13, 10,	12, 16, 7,	17,	5,
	II IV	VI		

per cent. as large as the average of the best group. These relations should be understood to hold only for the conditions under which the tests were made. It is probable that some yokes, particularly No. 16, would show up worse under actual working conditions of long continued work than it did under the short time tests actually made.

Table III gives comparative measurements of the different yokes, and Figures 1 and 2 show the difference in designs of the yokes. Table III also indicates the area from which each yoke design came. No. 1 is the ordinary 'Nagpur' yoke in use at the Institute for several years and originally modified from a yoke brought to the Institute from Nagpur, C. P. Nos. 13 and 14 are modifications of the same yoke in an attempt to get smaller and larger areas of contact between neck and yoke. No. 5 was made to the design of Mushtaq Ahmad as an 'improved' yoke. No. 17 was modification of the 'improved' yoke to Madras design.

These measurements do not give any very clear clue to why one yoke is better or worse than another. The two worst yokes according to these tests showed the largest and

the smallest areas in contact with the neck. The measurement of the area in contact with the neck was perhaps the least satisfactory measurement made. Various methods were tried and none was found very satisfactory. The method finally adopted was to smear the yoke with lamp black mixed with oil ; then the yoke was carefully placed on the neck and pressed firmly down and back to get an impression. The yoke was then removed and placed on the ground, and a soft copper wire was bent to fit the shape of the impression. The wire shape was then carefully transferred to a sheet of graph paper and the area carefully determined by counting the squares. The areas so determined are only approximate. There is some reason to believe that the area recorded for No. 5 is high, but this did not invalidate the results as will be shown later. The weight of the yoke also does not appear to be a factor, at least within the limits of the weights of the yokes tested. The best group included the heaviest and some of the lighter yokes while the lightest yoke is near the bottom of the list. If anything, the evidence would be in favour of a heavy yoke. No other factor stands out as definitely explaining the superiority of one yoke over another.

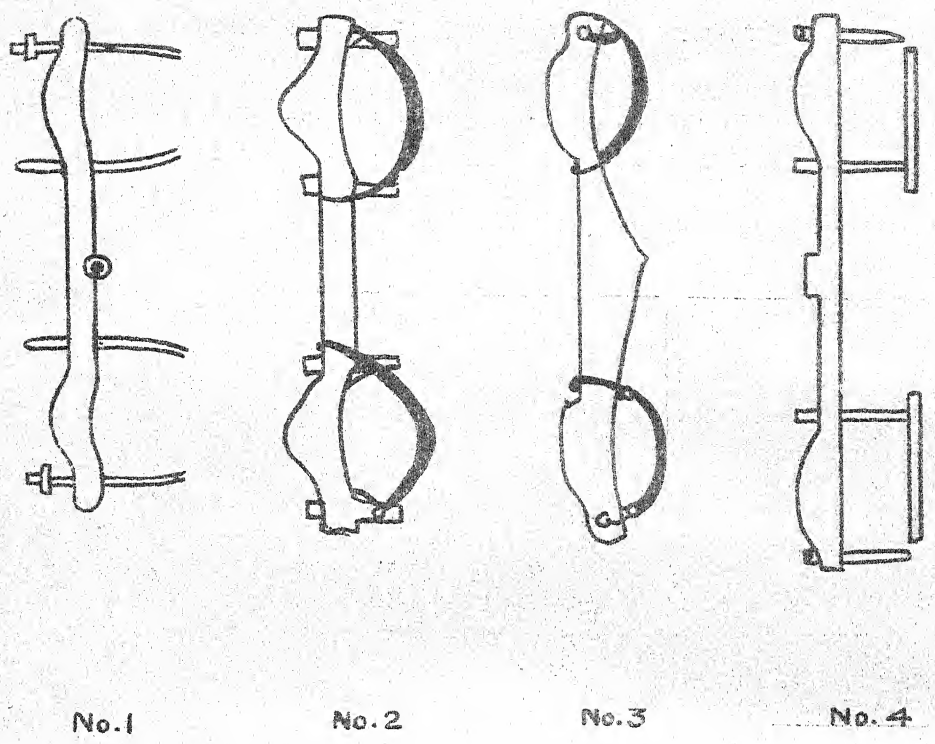
Tests of single bullock hitches

After completing the tests of yokes for pairs, it seemed desirable to investigate the usefulness of single animal hitches. In the replies from the Directors of Agriculture, Gwalior and Bombay had described essentially the same single bullock yoke of wood. Charley's leather harness had come to attention otherwise. In anticipation of these tests, an American horse collar had been imported and a similar collar had been made locally. A hitch known as a 'birh' is in common use in the area of Allahabad for hitching a single bullock in front of a cart when three animals are required, or for drawing a hand cart when only one animal is used. The imported collar was found to be too big for use on the animals available for tests and so was discarded. In studying the results of the tests for yokes for pairs, it appeared that probably the poor results from the tests of yoke No. 5 was due to the fact that it fixed the distance between the bullocks quite rigidly, allowing them very little freedom of individual movement and that the design of the part in contact with the neck was not in itself bad. In order to investigate this and to give an additional single animal hitch, one end of the No. 5 yoke was disconnected and modified slightly to enable it to be used as a single hitch. This gave a total of 5 hitches, suitable for single bullocks, to be tested.

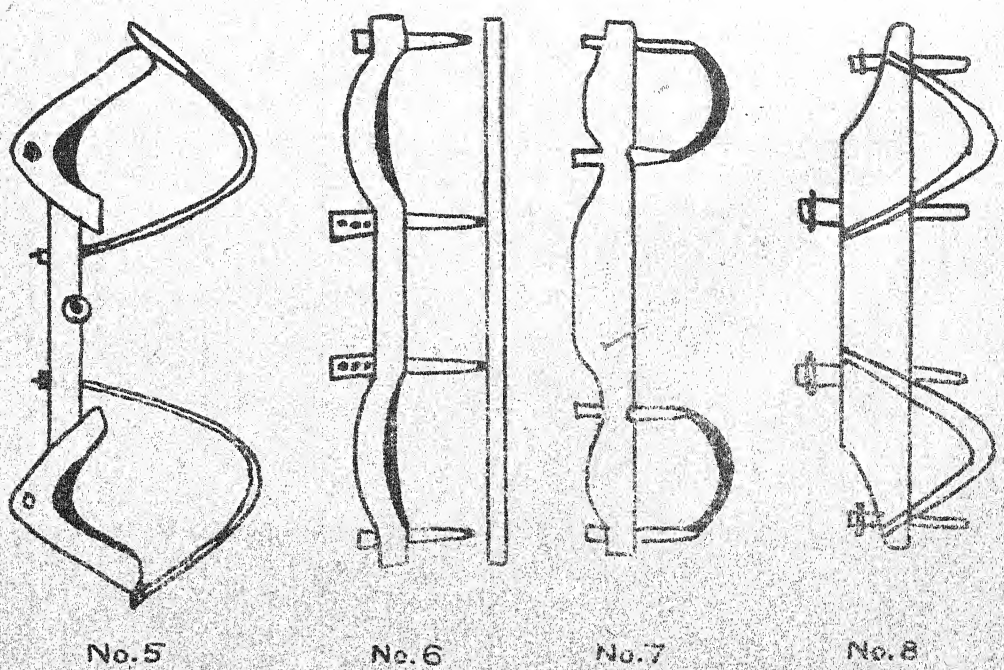
TABLE III

Details of yokes construction

Yoke No.	Province where yoke is used.	Weight of yoke in lb.	Average pull in lb.	Wood used in making yoke.	Length of yoke in ft. and in.	Width of yoke at neck position—in.	Length of yoke at neck position—in	Thickness of yoke at neck position —in.	Depth of curve of yoke at neck position—in.	Average area of contact between yoke and neck—sq. in. (10 bullocks).
No. 1	U. P. ..	26 with pipe	872	Babul	4-5	7	16	$1\frac{1}{2}$	H=$2\frac{3}{4}$" V=*nil*	52·138
No. 2	Assam ..	27	851	Sakhu	4-6$\frac{1}{2}$	7	12	$3\frac{1}{2}$	H=*nil* V=$\frac{1}{4}$"	42·965
No. 3	C. P. ..	24	880	Sakhu	4-6	$4\frac{1}{4}$	11	3	H=$2\frac{1}{4}$" V=2"	42·58
No. 4	Punjab ..	30	869	Sakhu	5·0	5	11	3	H=*nil* V=*nil*	40·455
No. 5	Punjab ..	30	721	Babul	4-8	5	9	3	H=*nil* V=$8\frac{3}{4}$"	60·112
No. 6	Punjab ..	26	862	Babul	4-7	$4\frac{1}{2}$	13	5	H=*nil* V=$1\frac{3}{4}$"	41·166
No. 7	Kashmere	16	826	Sakhu	4-6	$4\frac{1}{2}$	12	$2\frac{1}{2}$	H=*nil* V=*nil*	37·554
No. 8	C. P. East Circle	25	859	Babul	4-6$\frac{1}{2}$	4	13	13	H=*nil* V=*nil*	38·59
No. 9	Punjab ..	22	812	Sal	4-9	6	$9\frac{1}{2}$	$2\frac{1}{2}$	H=*nil* V=*nil*	39 215
No. 10	Bihar ..	28	836	Sal	6-3	$6\frac{3}{4}$	17	3	H *nil* V=*nil*	46·885

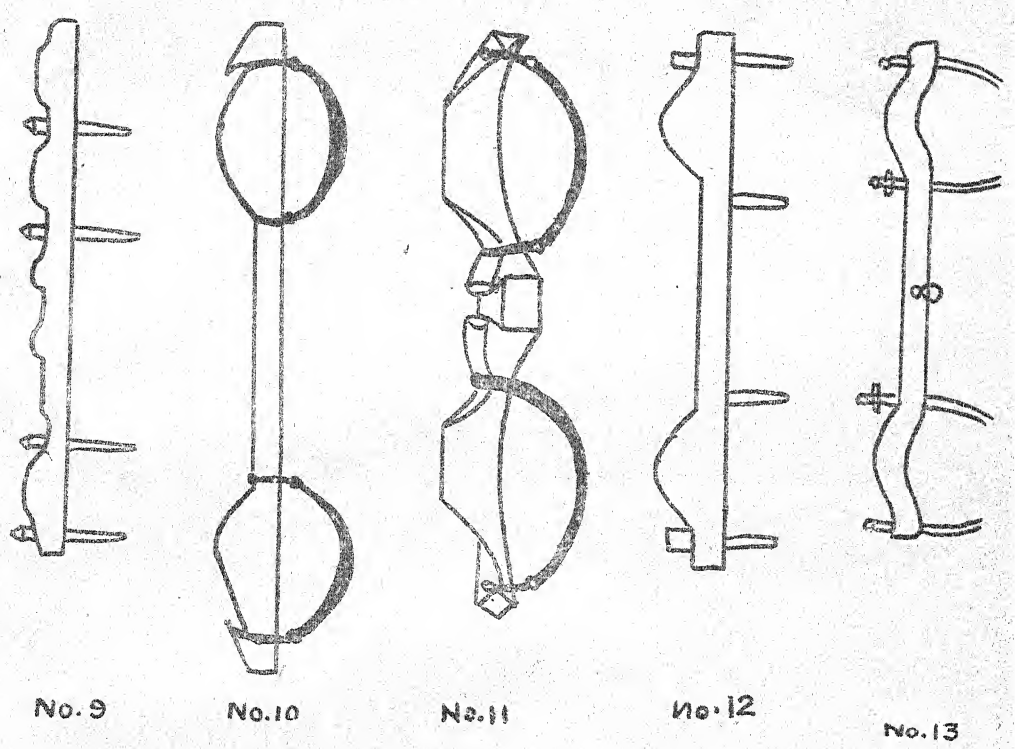


No.1 No.2 No.3 No.4

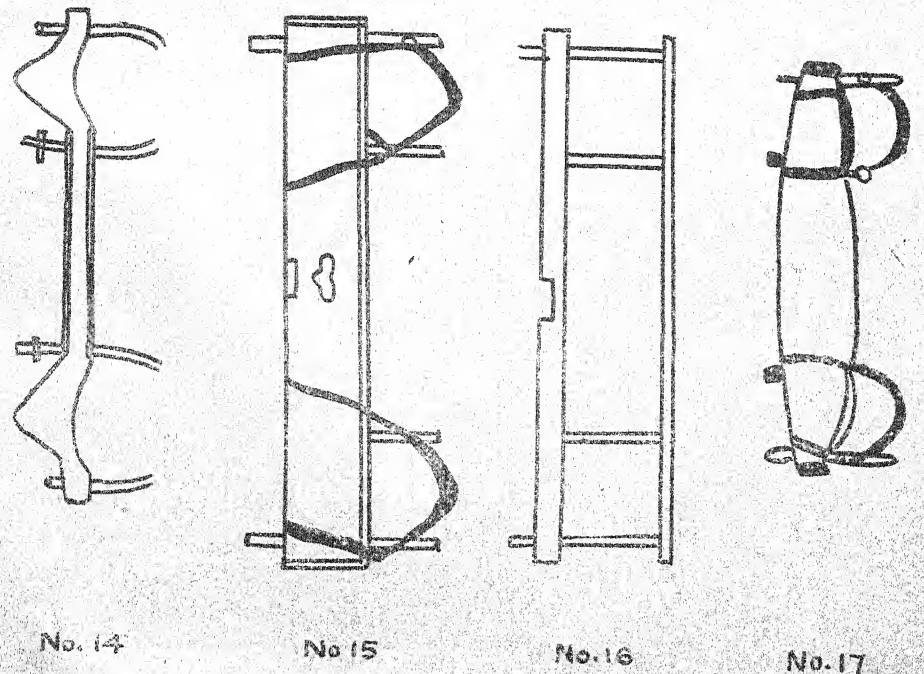


No.5 No.6 No.7 No.8

FIG. 1, SKETCHES OF YOKES.



No. 9 No. 10 No. 11 No. 12 No. 13



No. 14 No. 15 No. 16 No. 17

FIG. 2. SKETCHES OF YOKES

TABLE III—*contd.*

Details of yokes construction—contd.

Yoke No.	Province were yoke is used.	Weight of yoke in lb.	Average pull in lb.	Wood used in making yoke.	Length of yoke in ft. and in.	Width of yoke at neck position—in.	Length of yoke at neck position—in.	Thickness of yoke at neck position—in.	Depth of curve of yoke at neck position—in.	Average area of contact between yoke and neck—sq. in. (10 bullocks).
No. 11	C. P. .	35	870	Sal	4-4	7½	14½	3	H=1·1/8″ V=1·5/8″	56·625
No. 12	Punjab Country type	20	834	Sal	4-9½	6½	9	3	H=*nil* V=*nil*	40·261
No. 13	U. P. ..	18 with pipe	839	Babul	4-3	4½	12	2½	H=1¾″ V=1⅜″	40·01
No. 14	U. P. ..	22 with pipe	849	Sakhu	4 5	9	12	3	H=1″ V=2½″	59·86
No. 15	U. P. Hills	20	852	Sakhu	5 0	6	11	2	H=*nil* V=*nil*	45·87
No. 16	Local ..	20	832	Sakhu	4 ·9	3	10	Round	*nil*	35·36
No. 17	Madras Improved Cart yoke	35	782	Sakhu	3-10½	4	7	Round	*nil*	28·216

Essentially the same procedure was used with the single hitches as with the pair yokes. The same cart was modified by fitting shafts instead of a single beam. Five single bullocks were chosen, from among the 5 pairs used for the previous

tests, and trained to work single. Replicated series of 5 tests were made with each bullock of the five on each of the hitches. Table IV gives the results of the tests of the single hitches and the analysis of the data.

The above data is interesting not only because it gives an idea of the relative values of the different hitches but because of the indication it gives of the relative efficiencies of working of single bullocks and of the same animals hitched in pairs by the use of a common yoke.

The study of the pull possible with single hitches has two possible utilities. The possible desirability of using single animals instead of pairs in some circumstances and the question of whether some form of harness hitch with an equalising bar behind—a so-called double tree—might give more effective pulling power for pairs. The results with Mushtaq Ahmad's improved yoke indicates the undesirability of too rigidly restraining the bullocks against sidewise movement. While the ordinary yoke gives more freedom than does the Mushtaq Ahmad yoke, it gives less than would be possible with a harness and double tree hitch. This needs further investigation. If 1/6th of the body weight or 1/4th of the maximum pull, two figures which seem to be roughly equal in the data from these tests, should prove to be reasonable loading, the draft ability of the bullocks tested would come approximately within the range of loads commonly required or imposed by ordinary small implements, 100 to 120 lb. pull. The practicability and desirability of using single animals of a slightly larger size instead of a pair of very small animals on the smaller farms needs to be investigated further.

The reason, or at least one reason, why the Poona-Gwalior yoke performed poorly on single animals seemed to be at least partly because of the poor fit on the neck of the bullocks used and because it bore on the point of the shoulder joints. It appears to have been designed for animals having a much thicker neck than the test animals had. Bullocks differ from horses in having a very thin covering of muscle and flesh over the shoulder joint and pressure on the joint seems to be uncomfortable to the bullock, while it is precisely here that the horse does its pulling. Part of the superiority of the half of the Punjab yoke seemed to be that it did not come down to the shoulder and was narrow at the top.

Conclusions

1. Yokes of the general type represented by types 1, 3, 4, 11 are definitely better than some others, especially types 12, 16, 7, 17, 5.

2. Yokes which definitely restrict side movement of the bullocks are undesirable.

3. Except for the restraint of side movement, no very clearly defined reason for the superiority of one yoke over another has appeared from these studies.

4. The training and control of the bullocks very greatly affect the results.

Table IV.

Data of tests of single bullocks hitches.

Bullocks Team No.	Pull in pounds with each yoke (Average of 30 observations)						Average for bullocks
	Weight in pounds	Birh	American modified	Punjab	Madras harness	Gwalior yoke	
34	760	611	589	579	485	456	544
35	820	464	438	407	418	445	446
15	910	651	631	609	510	523	585
24	826	617	570	570	519	491	553
14	780	698	591	618	574	529	536
Average for yokes	..	592	564	569	501	489	..

ERADICATION OF 'KANS' GRASS IN THE CANAL AREAS

BY

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In these days of general food scarcity every effort made towards raising the food production of the country will not be in vain. As a result of 'Grow More Food Campaign' hundreds of thousands of additional acres are being brought under cultivation. Every effort should also be made to conserve and increase soil fertility and to save crops from their several enemies.

One enemy which causes extensive damage is a grass weed called 'Kans'. This weed, once it takes root in a field, establishes itself quickly and spreads so rapidly as to render the entire land unsuitable for cultivation. By checking the spread of this nefarious perennial weed and totally eradicating it, not only will vast tracts be saved of further drain on their fertility, but also a considerable increase will be achieved in crop production.

The methods at present known for eradicating 'Kans' grass are (1) The Indore method, (2) The Central Provinces method, and (3) The Izatnagar method, all of which having almost the same salient features, *viz.*, deep cultivation, picking of the root stalks and smothering of the remaining underground vegetative parts by growing some thick kharif crop like sann-hemp, etc.

Some of these methods were tried to eradicate 'Kans at the Harsi Experimental Farm, Bagwai (P. O. Bhitarwar) Gwalior State, but they failed to eradicate it completely. The 'Kans' roots, which go pretty deep into the soil, are not completely pulled out by an ordinary plough ; they grow again and infest the land. The large number of men employed for collecting, digging and pulling the 'Kans' roots in the methods mentioned above make the expenditure exhorbitant. In the method evolved and dealt with below, this work is accomplished by the use of a simple implement, the 'Tooth-pegged patela'. The physiological factor that the 'Kans' grass is greatly susceptible to water-logging has been made use of in smothering the residual underground parts of the 'Kans' grass. This method, however, is applicable only in the areas where water supply for irrigation is in abundence.

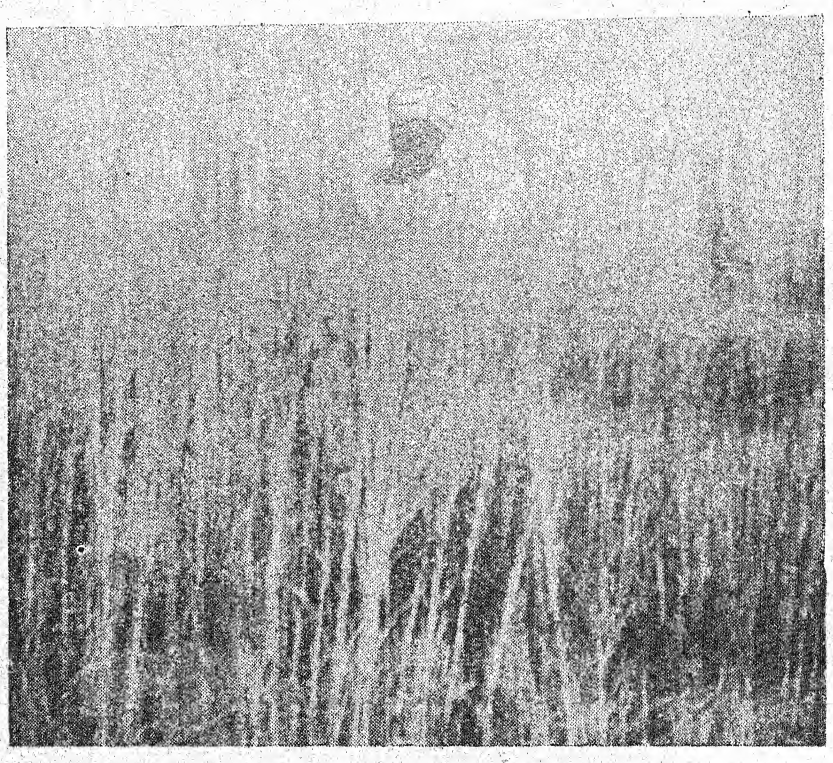

PLATE I.
Field heavily infested with 'Kans' grass.

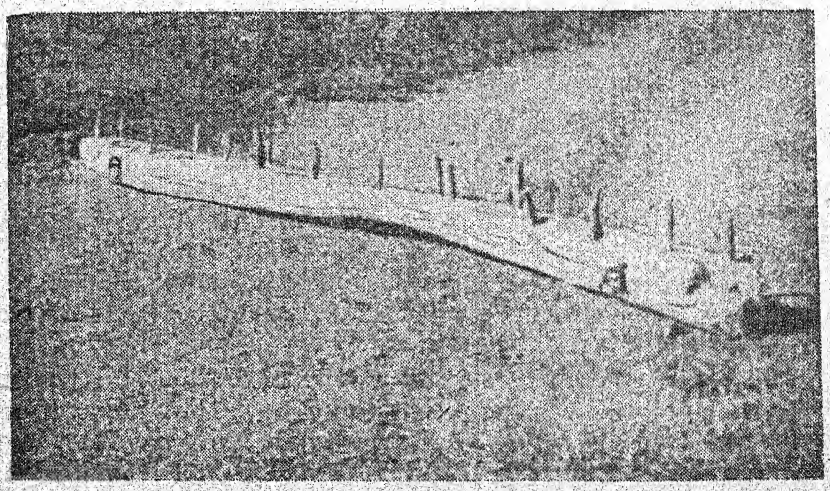

PLATE II.
Tooth-pegged patela.

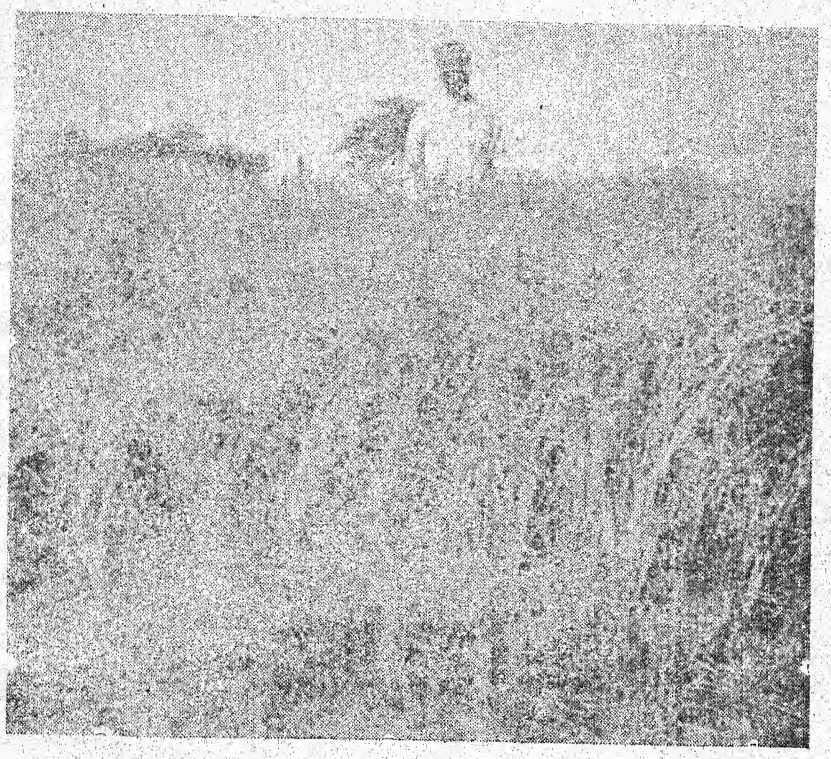

PLATE III.

Transplanted paddy crop at the time of haruest, raised in a field after Cleaning 'Kans' grass.

According to this method, during the month of May, the aerial portion of the 'Kans' is first cut and then the land is lightly irrigated in order to soften the soil for cultivation. The soil, when it returns to a suitable tilth is ploughed with any deep cultivating improved iron plough (Sabul plough was used during the experiments). The land is harrowed once or twice during the remaining summer period in order to expose the unpicked 'Kans' rhizomes to the hot sun, so that they are dried and killed.

With the onset of rains, the land is divided into small points of about half an acre in size. Bunds about one foot high are raised on all sides or at any rate on three sloping sides so that sufficient water, say from six to eight inches deep, can stand all over the plot. The plot is then flooded with water and allowed to stand for a day or two so that the water reaches deep into the soil and loosens the 'Kans' roots. If soaking is very pronounced more water is allowed in the plot to fill it to the maximum.

Now, a tooth-pegged patela is run over the plot. This implement is an ordinary patela about twelve feet long in which wooden pegs about six inches high are fixed in the holes made for the purpose. The pegs are inserted equi-distantly all over the working side of the patela, the distance from one peg to the other being about nine inches on all sides. The pegs are tightly fitted so that they may not give way during the course of work, but in spite of it a number of spare pegs are kept in reserve to replace any pegs that may be broken or lost in water during work. The patela is drawn by two pairs of bullocks and worked by two men who stand on it while driving. It is run to and fro in both directions across the plot. When the patela arrives at the end of the plot it brings with it underground rhizomes of 'Kans' which are entangled in the pegs and pulled out. These are collected by men outside the plot, and may be made into compost. The process is continued till no more of weeds are collected and the plots get puddled thoroughly. It takes about eight to twelve hours to clean half an acre of plot in this way. Care should be taken that sufficient quantity of water stand in the field when patela is run, otherwise the work will be inefficient due to mud and there will be too much exertion on the bullocks.

After the cleaning operation, paddy should be sown in these plots. If seedlings are available, transplanting is done; otherwise sprouted paddy seeds are sown broadcast when the field is in a puddled condition. The water on the plot is drained away twenty-four hours after sowing the seed. Later, the plot is again covered with water as the seedlings grow. Care is taken that during the course of the growth of paddy crop, sufficient water is allowed to stand in the field to meet the requirements of the crop. Transplantation of paddy is preferable in this respect as it is not necessary to drain the water off. The water is, however, changed intermittently to ensure a good paddy crop. The plots are emptied a fortnight before the harvesting time so that uniform ripening of the paddy crop takes place.

On harvesting the paddy it is found that not a trace of 'Kans' is left in the field. The paddy crop which is obtained in the 'Kans' laden areas, by this process is usually very good. The yields on the Harsi Experimental Farm, Bagwai, have been from twenty to twenty-five maunds per acre.

It has been observed that the fields are usually divided into small blocks and the ridges demarcating the neighbouring fields are never ploughed or cleaned. These ridges in the 'Kans' affected areas act as seed-bed for fresh infestation. So in order to ensure complete eradication of the weed these ridges should not be allowed to remain and be ploughed up at the time of cleaning the fields.

In addition to the eradication of 'Kans' there are some further advantages which accrue by the adoption of this method. These being, (1) in other methods, after cleaning operations sann-hemp is sown in the fields, while in the method described above, paddy, an important food crop, can be raised, which will compensate to a great extent for the expenses incurred in the cleaning operations. (2) In addition to the 'Kans' other weeds are also exterminated and the field afterwards presents a clean appearance. (3) The surface level of the field is greatly improved. (4) No weeding of the paddy crop is required which is usually compulsory in other paddy fields.

The 'Kans' is completely wiped out of the fields by the above method. It is, however, recognised that some expenses are incurred and it is beyond the means of an average cultivator to meet them. They are also very conservative and lethargic and take the least care for the improvement and development of their land. If vast areas of fertile land, heavily infested with 'Kans' are to be reclaimed and saved from further destruction, the work should be taken up by the Provincial and States Agricultural Departments. 'Kans' eradiction weeks should be organised, and the work should be carried out with the co-operation of the cultivators, by granting them suitable subsidy.

COTTAGE AGRICULTURE AND VILLAGE SCHOOLS

By

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The source of income of the villager is agriculture. The cultivator usually has neither enough land nor resources to enable him to produce sufficient from his land for his needs. It is no wonder that under these conditions of extreme poverty and with plenty of idle time, he is unable to maintain an equilibrium of mind, and engages in the intrigues which have

made village life so unhappy. It has often been suggested that cottage industries may not only keep the people busy in their spare time but also help them to make additional income. Mahatma Gandhi's *charkha* is considered by some a solution of the present miseries of the cultivator. It is true that this may help in solving to a very great extent the problem of cloth. But this does not very much help him in the problem of food which is the first necessity of life. The cultivator under the force of circumstances for generations has developed a taste for agriculture and any practical way to solve his difficulties through this vocation will appeal to him the most. Apart from this an outdoor agricultural life is conducive to health.

In view of the limitations of land and resources, large scale farming is out of the question for him. Kitchen gardening which can be done in the little space around his cottage and therefore assumes an appropriate name of cottage agriculture is the only possible remedy which can be suggested to keep him and his children busy through out the year and to solve, at least to some extent, the problem of his food. There are certain vegetables like cucurbits (Kaddu, Loki and Turai, etc.) which can be trained along the walls of the cottages. A few plants of Papaya and Banana can easily be reared with the help of the waste kitchen water. It is a well-established fact that more crops of vegetables can be taken off the land during a year than grain crops and the quantity of food produced per unit of land is also much more. Vegetables introduced in the diet of the cultivator make his food well-balanced and provide necessary vitamins required to keep him fit. Any surplus produce can find a ready market and be a source of regular income to the cultivator. Even a few pice a day earned this way will enable him to purchase the every-day necessities of his household like salt, gur, tobacco and spices, etc. During those hours when agricultural operations are not possible, the cultivator can take to his "Charkha" which can provide him cloth. Thus, cottage agriculture and spinning will keep him and his family busy and there will be no time for him to indulge in unnecessary gossips leading to the mean party-politics so prevalent these days in villages.

The scheme of kitchen gardening proposed above can be given a practical shape all at once by introducing this as a compulsory subject for training in the village schools. The school compounds may be utilized for raising seeds of common vegetables to meet the demands of the place. For practical training the school children may be taken for an hour or so to

the cultivator's gardens and made to work on their plots. This will not only give an incentive to kitchen gardening in the villages but will also create a fellow feeling amongst the villagers because all students will work together at everybody's place irrespective of his caste or creed and social and financial status.

This training may be imparted to the students under the guidance of experienced men in the line particularly of the class of Kachis and Malis. The garden section of the department of agriculture may also be able to supply a number of such men. The Tahsil incharge, who should be a trained technical man, may arrange short courses periodically at convenient centres to give practical hints to the school staff to enable them to make a success of the enterprize. The Head Master's work in this direction may be judged by the additional area brought under vegetables in the village and their quality. He may be rewarded for work deserving high commendation in order to infuse competitive spirit amongst the schools. Vernacular Middle passed young men may be given one year's training in the kitchen gardening at the agricultural schools of the province. Such men may ultimately be appointed instructors in the village schools.

Vegetable seeds and fertilizers may be provided, in the first instance at least, on subsidy. The cultivators should not be asked to make any payment in cash for the cost of seed, etc. It may be realized from them in the shape of vegetables on fixed dates which may be sold to meet expenditure on seeds and fertilizers.